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The

Tropical Agriculturist

OCTOBER TO DECEMBER, 1951

EDITORIAL

Sugar Cane in Ceylon

THE cultivation of sugar cane in Ceylon probably dates back to very early times, but no large-scale attempts at the manufacture of sugar were apparently made until early British times. It is recorded that in 1842 there were ten or twelve sugar factories in operation and that the Island was nearly independent of imports at the time. It is also of interest to learn that sugar was exported from Ceylon from 1845 to 1859 though the quantity exported never exceeded about 400 tons per annum. The crop was cultivated in certain parts of the Central, Southern and Western Provinces, but it was in the latter Province that development was greatest. From about 1860 the sugar industry declined and gave place to tea, rubber and other more remunerative crops. It was not, however, until 1912 that the last sugar mill at Baddegama in the Southern Province was closed down. Spasmodic efforts to revive the industry as a capitalist enterprise were made up to as late as 1918, but without success. However, the industry never died out for even at the present day a cottage industry exists in the Nagoda-Baddegama area where a few bullock-drawn power mills maintain a profitable trade in brown sugar and molasses.

Realizing the importance of sugar in the economy of the country, the late Sir Frank Stockdale when Director of Agriculture, viz., from 1915 to 1928, endeavoured to resuscitate the cultivation of the crop, and to this end had trials conducted with imported varieties of cane and improved methods of cultivation both in the Nagoda District and where land suited to the crop was available, e.g., at Allai in the Trincomalee District. These trials proved that

very satisfactory yields of cane and sugar could be obtained in our dry zone areas where water for irrigation was available, and that there were particularly good prospects for the establishment of a successful sugar industry in the Eastern part of the Island. Capitalist enterprise was attracted by these prospects, but for one reason or other the project did not materialize.

In 1942, the then Minister of Agriculture, the Hon'ble Mr. D. S. Senanayake, appointed a Committee to review the possibilities of a cane sugar industry in the Island. This Committee reported very favourably on the proposition and recommended suitable areas for development under the crop where irrigation facilities were available or likely to be feasible. Though the proposal for a sugar industry was viewed favourably by Government, the aftermath of the War enforced a time lag before a start could be made with the multiplication of planting material to supply the requirements of a 6,000-acre cane plantation. In 1948, however, the greater part of the departmental farm at Polonnaruwa was earmarked for the cultivation of the crop and by the end of 1950, thanks to the efforts of the Agricultural Officer, North-Central Division, Mr. C. R. Karunaratne, nearly 350 acres were planted out with four or five imported varieties of cane, which the earlier research work of the officers of the Botanist's Division had shown to be the most promising. Yields obtained from part of this acreage have already been very encouraging and there is every indication that, with more intensive methods of cultivation, appreciably higher yields could be obtained.

Early in 1951, thanks to the good services of the Food and Agricultural Organization, an expert in sugar cane cultivation was obtained, in the person of Dr. C. Van Dillewijn, to advise on and direct the development of a large-scale sugar project. With his considerable experience of cane cultivation in Java and his deep knowledge of the crop in other parts of the world, Dr. Dillewijn's services should prove of inestimable value to the renascent sugar industry of Ceylon. The article by him in this issue of *The Tropical Agriculturist* entitled " Sugar Cane in Ceylon " merits the serious study of every one connected with the crop. Dr. Dillewijn has initiated a number of investigations on sugar cane at Polonnaruwa and the results of some of these have already furnished valuable information. He is confident that provided the industry is organized on sound and correct lines and the pitfalls which have undermined the industry in some countries are avoided, Ceylon could develop a very successful sugar industry within a few years.

Government has decided that a start with the establishment of a sugar industry on a commercial scale should be made, and details of policy and organization are being worked out. There is, therefore, every reason to hope that with the co-operation of all those connected with this enterprise, and under the able guidance of the F. A. O. Adviser so far as the cultivation aspect of the project is concerned, a modern sugar industry in the Island will be a reality before very long.

Sugarcane in Ceylon

BY

C. VAN DILLEWIJN

INTRODUCTION

THE commercial manufacture of sugar in Ceylon has been frequently suggested. The recent revival of interest has been so marked that the early establishment of a sugar industry in this Island appears possible. In view of the far-reaching agricultural, economic and social effects of such an industry, a careful consideration of the factors concerned is desirable. With efficient planning and expert guidance a sugar industry will not only pay but will benefit the people engaged in it. Full advantage can be taken of the experience of other cane-growing countries ; their mishaps and failures provide particularly profitable lessons.

The sugar industry of no particular country should be copied—not even that of a country ranking high in efficiency like Hawaii or pre-war Java. A sugar industry, like most agricultural enterprises, is profoundly influenced by local conditions, and the lines on which it develops must ensure its suitability to these conditions. To put it clearly, Ceylon will not adopt the Java system, nor that of Hawaii, Australia or India. It will borrow from these and other countries the best features and adopt them to the framework of conditions prevailing in this Island.

In the following paragraphs a review of problems associated with the establishment of a sugar industry is presented. The review starts with general data on world sugar production and consumption, and is followed by a discussion of the requirements of sugarcane and prospects of the crop in Ceylon. The experimental work already in progress is then discussed and finally miscellaneous aspects are surveyed. It is hoped that this review will assist the authorities who have to decide on the organization of the industry, and that, in addition, it will provide information to all those who are interested in the development of this enterprise.

WORLD PRODUCTION

The total annual sugar production of the world approximates 30,000,000 metric tons of which nearly two-thirds or 20 millions are derived from sugarcane and one-third from sugar beet. The share of some individual sugarcane

countries is represented in fig. 1 which shows that Cuba is the major contributor, followed by India plus Pakistan. The column for Ceylon indicates the production which would be required to make this country independent of imports (120,000 tons). As for India and Pakistan, it must be pointed out that the major part of the sugar produced in these countries consists of gur and similar crude sugars. In composing fig. 1 and other graphs these products have been evaluated at half the value of white sugars.

The average sugar yield per unit of area is shown in fig. 2. This figure relates to pre-war conditions since as a result of war damage and post-war troubles recent figures are not representative of some of the major sugar producing countries like Java, the Philippines and Formosa. Fig. 2 shows that Java and Hawaii led in yields per acre. It must be pointed out that the cane in Java is harvested at about one year of age while most of the cane in Hawaii is derived from biennial crops. Consequently, the yield per acre and per unit of time was highest in Java. The figure for Ceylon indicates the yield which can be expected *provided efficient methods are applied both in the field and in the factory.* It indicates that under these conditions Ceylon will compare favourably with the leading cane countries of the world.

A comparison between figures 1 and 2 shows the interesting fact that the two largest sugar producers have low yields per unit of area. This applies to Cuba and even more so to India plus Pakistan ; the latter area has the lowest yield per acre. This indicates that the annual sugar output in these countries is due rather to extensive cane acreages than to high yields per acre.

Another interesting fact is that Java and Hawaii which lead in sugar yields per acre, are the countries which have spent most money on sugarcane research. In both countries the sugarcane research institutes have been entirely run and financed by the private sugar industry without any government help.

SUGAR IMPORTS

The yearly imports of sugar in Ceylon are presented in fig. 3. With the exception of the war years, imports have shown a gradual increase during the last twenty years. The same figure shows the trend of population ; the relationship between increasing population and increasing sugar imports is obvious.

CONSUMPTION PER CAPITA

The average quantity of sugar consumed per person per year varies widely in different countries. Fig. 4 shows that U. S. A. heads the list, closely followed by Australia. The European average is about 47 lb. per year per head. Consumption in South East Asia is much lower ; here, Ceylon and India plus Pakistan lead.

PROSPECTS OF SUGARCANE IN CEYLON

There is little doubt about the possibilities of successful sugarcane growing in Ceylon. Examination of fig. 5 which shows the location of the main sugarcane producing countries, indicates that the world sugarcane

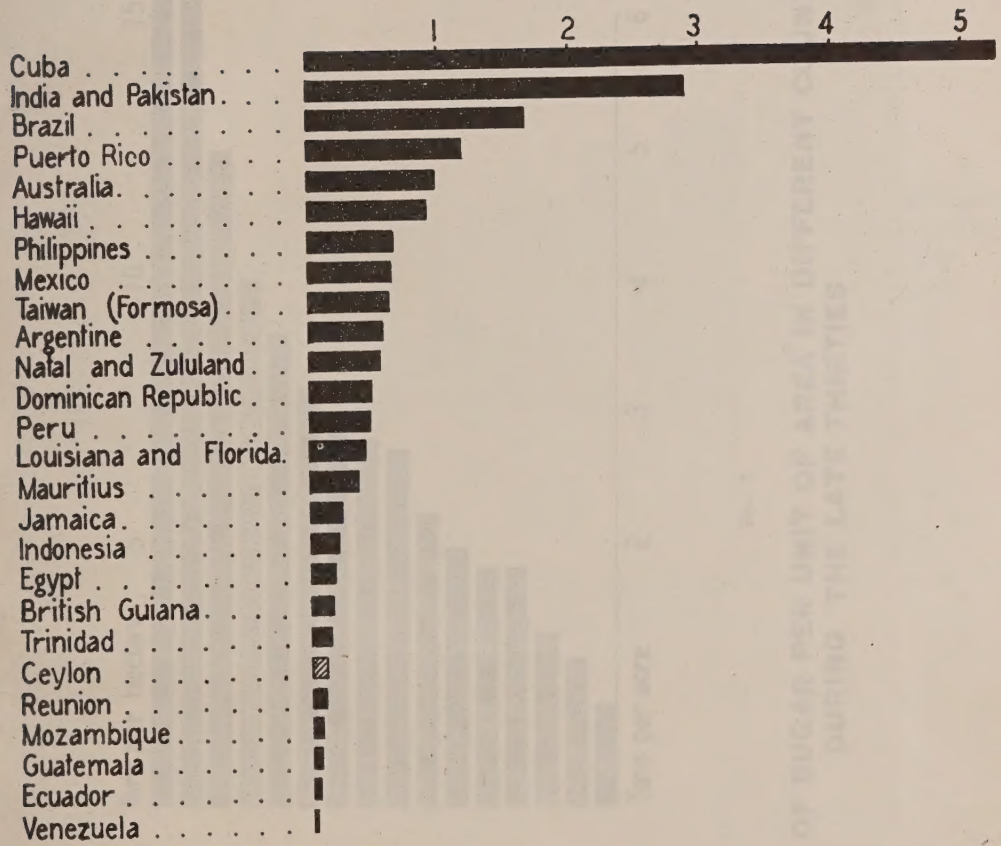
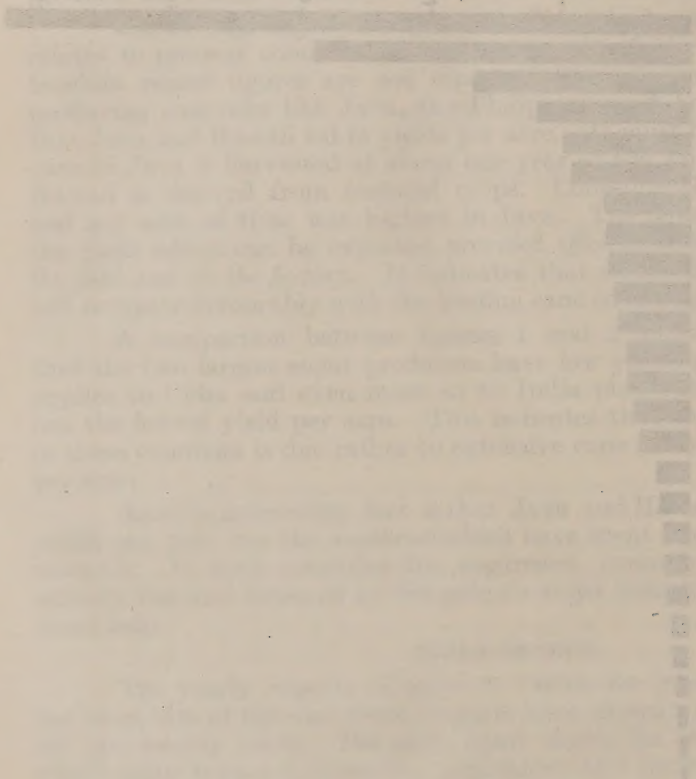


Fig. 1

PRODUCTION OF CANE SUGAR IN SOME COUNTRIES FOR THE SEASON 1948/1949 IN MILLIONS OF METRIC TONS



PRODUCTION OF CANE SUGAR IN SOME COUNTRIES FOR THE SEASON 1943/1945 IN MILLIONS OF METRIC TONS

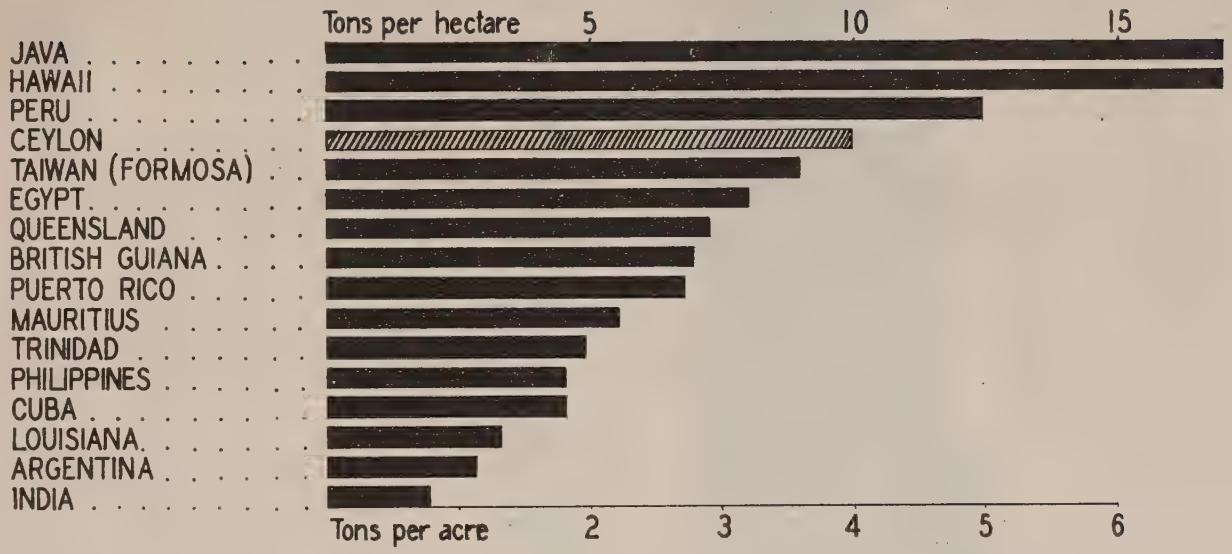


Fig. 2

AVERAGE YIELD OF SUGAR PER UNIT OF AREA IN DIFFERENT COUNTRIES DURING THE LATE THIRTIES

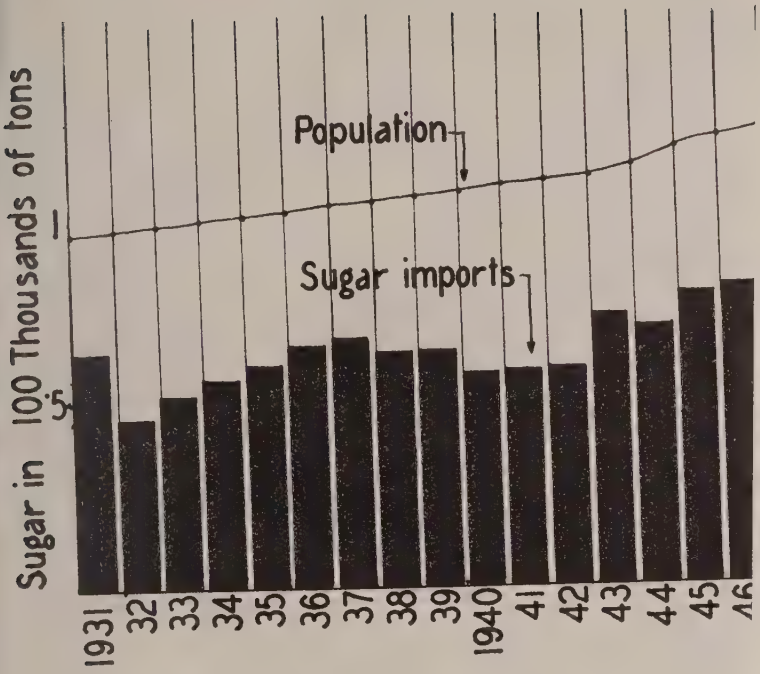


Fig. 3

TRENDS OF SUGAR IMPOR
OF POPULATION IN CE'

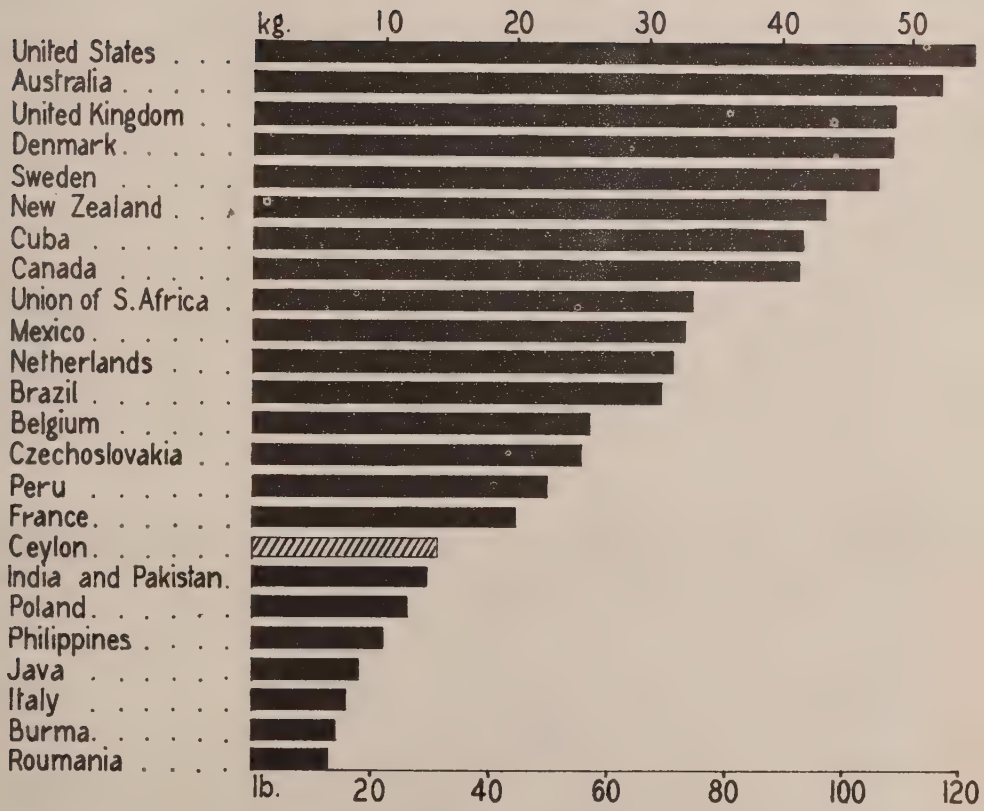


FIG. 4.—Annual sugar consumption per capita in different countries

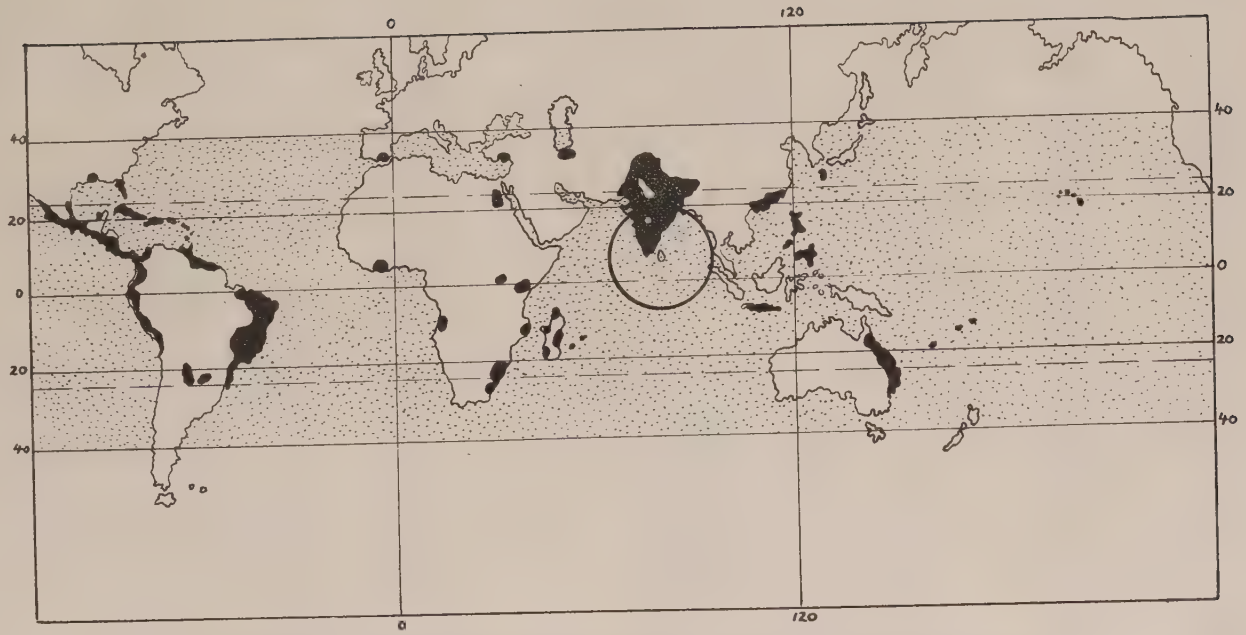


FIG. 5.—Location of the main sugarcane areas (solid black). Ceylon is in the centre of the world sugarcane belt which runs between 40° N. and S. latitude

area stretches between 40° N. and S. latitude, and that Ceylon is located right in the centre of the sugarcane belt. Moreover, a wild form of sugarcane (*Saccharum spontaneum*) is indigenous in Ceylon, while cultivated forms of sugarcane although on a very limited scale, have been grown in this Island for centuries.

Finally, field experiments at Polonnaruwa Experimental Farm in the dry zone have indicated that very satisfactory yields can be obtained, provided that irrigation facilities and cultivation methods are satisfactory.

REQUIREMENTS OF SUGARCANE

The natural factors governing the yield of sugarcane are climate, soil, and water. The human factors are labour, research, and management.

Climate.—Sugar in itself consists only of carbon, oxygen and hydrogen, elements which occur in the air and in water. Out of these three elements sugar is synthesized in the green leaf under the influence of sunlight. The paramount effect of sunlight on sugarcane has been demonstrated in Hawaii where cane plants were grown in pots filled with the same kind of soil. Half the number of pots were placed in a sunny climate, the other half in a cloudy locality. Care was taken that all other factors (watering, fertilization, &c.) were uniform. On harvesting, it was shown that the crop cultivated under bright sunny conditions had yielded more than three times the quantity of sugar produced by the crop grown under cloudy conditions.

The climate in the dry zone of Ceylon is characterized by much sunshine during the major part of the year since the wet season does not last more than two or three months. Moreover, the temperature is fairly high all the year round.

Soil.—Sugarcane grows well on a wide variety of soils. According to JOACHIM's soil map of Ceylon, a large area of the dry zone consists of brownish, lateritic soils. Field experiments have indicated that these soils give very satisfactory sugar yields.

Irrigation.—The water supply in the dry zone of Ceylon is limited. Although there are still many water reserves which can be made available in the future, the main problem in the dry zone will be to utilize the available quantity in such a way as to produce as much food as possible. In this connection it is important to note that in general, sugarcane does not require more water than paddy, although the growing period of the former is 14 months as compared with 3 to 6 months for the latter. Moreover, under Ceylon conditions, one acre of cane produces three times the food value (expressed in terms of calories) of one acre of paddy. This means, that the *relative water requirement* of cane is only one-third that of paddy.

Labour.—Sugarcane is a crop the cultivation of which can be easily adjusted to local labour conditions. In countries with abundant and cheap labour, like Java and India, many cultural operations are performed by hand. In countries where labour is expensive and scarce, like Hawaii and

Australia, cultivation is highly mechanized. The great flexibility of sugarcane in this respect is demonstrated by the fact that in Java 2 to 3 man-days are required for the production of one ton of cane while the corresponding figure for Hawaii is 0·38.

Research.—It has gradually become an accepted fact that large agricultural and industrial enterprises can succeed only if they are founded on research. In a previous paragraph attention has been drawn to the fact that the most efficient sugarcane countries of the world (producing the highest sugar yields per acre) are those with the best experiment stations. Though there are many matters on which opinion is divided in respect to sugarcane, there is a general consensus of opinion that funds devoted to research pay high dividends. For this reason the first step in preparing a sugar industry in Ceylon, has been the establishment of a Sugar Experiment Station at Polonnaruwa where a start has been made in the investigation of basic problems in cane-growing. A series of field experiments has been laid out, and parallel with these field activities, laboratory research has been initiated.

Management.—Conducting research is one thing, the application of its results another. The translation of the results of research into field practice is of great importance and is the main function of the management. It is significant that the countries which lead in sugar yields per acre, are characterized by the fact that their field practice keeps pace with the achievements in research. In many countries there is a gap between research and field practice, and in India for instance, the gap is wide.

THE CULTURE OF SUGARCANE

Sugarcane is a tall grass ; actually it is the tallest of commercially grown grasses. Like other grasses, its stem is composed of joints, each bearing a leaf and a bud.

Planting in Ceylon is performed during the first half of the dry season by placing cuttings in furrows. The distance between the furrows is three or more feet from centre to centre. The cuttings are lightly covered with earth (fig. 6A), and irrigated at regular intervals. When adequate fertilizers are applied and weed development is kept under control, the buds readily germinate and develop into vigorous shoots. As the plants grow older the soil from the ridges is gradually removed and placed in the furrows. Usually two earthings up in addition to the light covering at planting, are thus carried out : the first at the age of one to two months (fig. 6B), the second at about three to four months (fig. 6C). At the first earthing up, most of the soil from the ridges is removed leaving only low ridges and shallow furrows. The final earthing up consists of hilling soil against the plants with the result that ridges occupy the place of the former furrows and *vice versa* (fig. 6C). The purpose of the final hilling up is twofold : first, to give support to the plants in order to prevent lodging, and second, to provide drains between the cane rows for the run off of water. Consequently the final earthing up has to be accomplished before the start of the rainy season.

FIG. 6.—Successive stages of earthing up. A, at planting, the cutting is lightly covered with earth; B, the major part of the ridges is removed and deposited into the furrow; C, final earthing up.

Cane matures in Ceylon during the dry season and harvesting takes place at the age of 10–15 months, depending on the time at which the cane was planted. In this connection the important fact should be stressed that the long duration of the dry season in Ceylon permits of a long crushing season. This is of considerable economic importance since, generally speaking, a longer crushing season permits a smaller factory thus lowering the overhead factory costs per ton of sugar produced.

After the cane has been harvested, the underground part of the plant produces shoots which give another crop, viz., the first ratoon. The same field can produce several ratoon crops, the number of the latter depending on the care given.

INTRODUCTION OF IMPROVED METHODS

As mentioned previously, research is the foundation of agricultural and industrial projects. For this reason a series of field experiments was started this year at Polonnaruwa. They serve a dual purpose. In the first place, they provide the basic facts on which the new industry will be founded. In the second place, they serve as a training ground for the future field staff.

As to the training of field personnel and the introduction of improved methods, the following experience may be of interest. The conventional way is to start at the local level of cane cultivation and to increase the efficiency by successively introducing better methods. This system is, however, slow and its greatest drawback is that the field employees have no clear idea of the goal aimed at, viz., a perfect stand of cane.

Another system has accordingly been developed and this has given satisfactory results in various countries. It starts at the other end by growing perfect cane, viz., a dense field with a uniform stand of uniform stalks.

Once a standard has been set by the growing of perfect cane, the next step is to simplify the cultural methods gradually in order to achieve an economic system of cane-growing. This implies the omission of all non-essential treatments, the simplification of others, and the introduction of mechanization, the extent of the latter depending on the availability and the wage levels of labour. But while reducing the field costs to a minimum, the general development of the cane and its yields should remain approximately the same.

Since this system has worked well in various countries and under diverse conditions, it has also been introduced in Ceylon. It has the advantage of establishing a high standard of cultural methods from the very beginning. The general level of these standards will be maintained in the future although the methods of cultivation will gradually be simplified and mechanized in order to secure an economic cost price of the sugar produced.

EXPERIMENTS

Research.—It takes about three years to establish a sugar industry. Jungle has to be cleared, land has to be levelled and irrigation ditches must be cut. Moreover, a factory must be assembled and erected. This period of three years can be used with advantage for conducting field experiments to

obtain answers to fundamental questions, and to place the whole industry on a sound footing. In the following paragraphs some of the problems involved will be indicated.

Planting material.—In general, sections of the stem or entire stalks are used as planting material. The cheapest planting material are top cuttings, viz., the non-millable hard section of the stems. They are of no value to the factory since they contain little sucrose and much glucose and molassigenic substances. For this very reason they constitute excellent planting material, and since top cuttings are rejected by the factory, their cost is practically nil. This planting material is, however, only available during the milling season and only at a rate which corresponds to the rate of harvesting. When planting has to be done before or after the crushing season, or when the rate of planting exceeds that of harvesting, other parts of the cane stalk, so-called stalk cuttings, have to be used as well. This means that material which would have provided millable cane to the factory, has to be sacrificed for planting purposes. It is obvious that under these conditions every effort should be made to reduce the use of planting material as much as possible.

A wide variation exists in this respect. While in some countries one or two running rows of entire stalks are planted, in others stalk cuttings containing two to five buds are used.

Under these conditions only part of the buds germinate, often as few as 25 per cent. This poor percentage is largely due to the phenomenon of top dominance which denotes the fact that a germinating bud tends to inhibit the development of other buds of the same stalk or cutting. Since each healthy bud is able to produce a complete plant, it is obvious that in order to reduce the use of planting material, the rate of germination has to be raised as high as possible. One way of achieving this purpose is provided by the " rayungan " method.

This method consists essentially in severing the soft upper section of the cane plant. Soon after topping the upper buds start developing shoots (fig. 7) which at an age of four weeks are ready for harvest. The removal of these shoots induces the lower buds to develop. After these have been harvested, the next lower buds develop, and so on, till all buds along the stalk have germinated. Each shoot together with part of the stem from which it originated, is severed separately and the leaves are trimmed in order to reduce the loss of water by transpiration. This planting material is called " rayungan " and the successive stages of development are depicted in fig. 8. Planting is done by grasping the piece of cane to which the rayungan is attached like a handle (fig. 9) and pushing it gently into muddy soil. Not more than 20 rayungans are required per furrow of 30 feet length (fig. 10) as compared with some 200 buds when planting two running rows of entire stalks. The fundamental principle of the rayungan method as compared with conventional methods is that in the former germination of the bud occurs on the growing mother plant and results in a higher percentage of germination.

FIG. 7.—Decapitated cane stem showing sprouting of the upper lateral buds

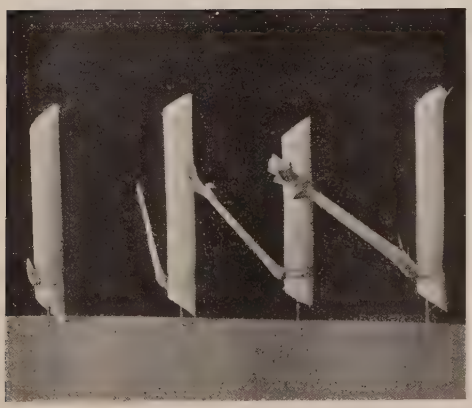


FIG. 8.—Successive stages of the development of a rayungan

Fig. 9.—How to hold a rayungan at planting

Fig. 10.—Part of a field planted with 20 rayungans per furrow of 30 feet length

FIG. 11.—Mode of tiller formation in rayungans.
Left, planted obliquely ; right, planted horizontally

FIG. 12.—Cane field at an age of four months which has closed in. Practically no light is admitted to the soil and therefore weeds are smothered

The young plants are irrigated at regular intervals and fertilizer is applied in the experimental fields to each plant separately by means of a fertilizer spoon. Under normal conditions and when proper care is given, the percentage of gaps is less then five per cent. Tillering starts two to four weeks after planting (fig. 11) and the field closes in at an age of two to four months depending on the distance between the rows. Once it has closed in, a well developed cane field does not admit any appreciable amount of sunlight to the soil and the development of weeds is thus suppressed (fig. 12).

Varieties.—For practical purposes the wide collection of cultivated canes of the world may be divided rather arbitrarily into two groups: tropical and subtropical varieties. Only the former group is of importance to Ceylon, and some 25 varieties are now being propagated and tested at the Sugar Research Station. Out of these, POJ 2878, Co 419 and Co 421 have given very promising results. (POJ stands for Proefstation Oost-Java, and Co for Coimbatore.) The yearly introduction of promising new varieties from abroad is envisaged. For the present, importation has been discontinued pending the establishment of a quarantine station.

Row spacing.—The distance between the rows has a dual effect: it influences the yield of sugar and the development of weeds. Narrow spacing in general increases the sugar yield per acre and largely eliminates the weed problem once the field has closed in. Mechanical cultivation, however, sets a limit to spacing, and for practical purposes the problem is one of finding a compromise between what the crop requires and what is actually practicable in mechanization. In order to secure this information, the effect of row distance on the crop must be known, and for this reason replicated field experiments have been set down with three standard varieties and spacings varying from one to two metres.

Fertilizers.—Since fertilizers constitute an important factor in the cost of cane-growing, experiments have been started in which the effect of varying rates of the three main nutrients is investigated. These experiments will be permanent and will provide information on long-term fertilizer trends.

Irrigation.—Water is the limiting factor in the dry zone and therefore a rather detailed field experiment is being conducted in order to determine the minimum water requirement of cane. In one treatment water is applied as soon as the soil moisture is reduced to the wilting point; in the two others irrigation is delayed five and ten days beyond this point. A similar experiment in Hawaii has indicated the interesting fact that though cane growth ceases when soil moisture has dropped to the wilting percentage, sucrose storage may proceed at such a rate as to make up for the loss in cane yield. It is evident that a confirmation of the results obtained in Hawaii would be of considerable importance to the dry zone of Ceylon.

Time of planting.—Replicated field experiments in which cane is planted at monthly intervals have been set down. Since it is known that varieties may differ in their optimum planting time, three standard varieties are included in each experiment.

Time of harvesting ; maturity testing.—Besides planting time, the time of harvesting is of importance, and the age of a crop is fixed by these two factors. As cane approaches maturity, cane elongation gradually diminishes and finally ceases. The main criterion in fixing the date of harvesting is the stage of maturity.

In order to ascertain the maturity of a cane crop according to the conventional method, a representative sample of stalks is harvested, transported to the laboratory, crushed in the sample mill, and the juice is analysed. Stalk samples are taken at fortnightly intervals starting several months before harvest time. The curve representing the percentage of recoverable sucrose first shows a distinct rise, gradually flattens, and finally approaches the horizontal. By that time the crop has attained full maturity and is ready for harvest.

This method is rather laborious and, therefore, has never become a standard practice in most cane-growing countries.

During the past twenty years a rapid field method has been developed which is so simple and effective that there is no longer any excuse for omitting maturity testing from the programme of standard field practices.

It consists essentially of drawing a single drop of juice from hundred or more stalks by means of a juice sampler (fig. 13). The drops collect into a test-tube inside the sample apparatus ; one drop of the composite juice sample is put into a hand refractometer and the degree of maturity is estimated on the spot. The hand refractometer reading actually gives the percentage of total soluble substances in the juice, the so-called Brix. Since a high positive correlation exists between Brix and sucrose, it follows that both values run parallel : as long as the Brix increases, the sucrose content increases, and *vice versa.* Consequently for practical purposes the rapid Brix determination can be substituted for the troublesome old method of sampling entire stalks, crushing these in the laboratory, and analysing the juice thus obtained.

Diseases and pests.—So far, no appreciable damage has been caused by diseases or pests, although mosaic and borers do occur. As far as mosaic is concerned, many hybrid cane varieties are now available which resist or tolerate this disease. As for other diseases, the fact must be stressed that they are rarely damaging so long as cane is grown in small experimental plots. When, however, cane growing is extended to thousands of acres, one or more diseases or pests may become a serious threat. It seems as if the enemies of the plant require a certain time to adjust themselves to the new environment, possibly through hybridization. It follows that research on these problems must start in good time if epidemics are to be forestalled.

MISCELLANEOUS

In the preceding paragraphs the potentialities and problems of cane-growing in Ceylon have been reviewed. This is, however, only one aspect of the matter. Of equal importance is the question of how the new crop

FIG. 13.—Juice sampling apparatus (left) and hand refractometer (right) as used in maturity testing in the field

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The *Tropical Agriculturist*, Vol. CVII, No. 4, October–December 1951 issue, page 215, line 7 from bottom : *for* " fig. 6 " *read* " fig. 10 ".

will fit into the agricultural and social background of the country. There is, for instance, the question of whether cane should be grown on a plantation scale or by small holders.

Plantations versus small farmers.—Half a century of experience in other countries has shown that both systems have their virtues and defects. The plantation system which employs hired labour, has the advantage of higher efficiency. All operations are centred in one authority, supervision is more efficient than when thousands of small holdings are involved, and improved methods can be introduced rapidly on a commercial scale. Consequently, the sugar yield per acre is almost twice that obtained by small holders and the cost price of sugar is accordingly lower. From a social point of view the system of small farmers has distinct advantages which, although they cannot be evaluated in quantitative terms, should not be underestimated.

There is, however, a logical solution to this dilemma which combines the advantages of both systems while eliminating their drawbacks. To this end cane-growing is started by a corporation on a plantation basis which enables the introduction of efficient methods. The labourers have an opportunity of getting acquainted with the crop and once they are sufficiently trained to grow sugarcane efficiently, the plantation is divided into small holdings. Care should be taken that the transition from the plantation system to one of small farmers is gradual, and that after the change-over the farmers are ensured adequate technical assistance and advice. Briefly, under the system of compromise the field labourer of to-day, becomes the small holder of tomorrow. This system has been applied elsewhere with remarkable success both for the sugar corporation and the tenants.

Soil fertility.—Although most of the Ceylon soils are of ancient origin, they are capable of giving very satisfactory yields, provided their fertility is maintained. During the first years after clearing the jungle, the productivity of soils is, in general, high on account of the organic matter which has accumulated in the course of many years. This organic matter, however, disappears rapidly unless adequate measures are taken to conserve or replenish it. Sugarcane is a very useful crop in this respect as it leaves considerable quantities of organic matter in the form of root and stubble residues which in an average crop, amount to some four tons of dry matter per acre.

It is important also to stress the fact that sugar itself does not take any nutrients from the soil since it is solely made up of water and carbon dioxide. By incorporating the waste products of cane (trash, filter mud, &c.) in the soil, the depletion of the soil can be reduced to a minimum. Soil erosion is another aspect of soil fertility which must be considered. With regard to this the reader is once more referred to fig. 6 which depicts the system of furrows and ridges applied in cane growing. Since the cane rows run along the contours it follows that the numerous ridges act as ever so many little bunds which prevent the soil from eroding.

Crop rotation.—In many countries cane after cane has been grown without interruption for many years with the result that soils have been exhausted. Where virgin land was available, forest was cleared and cane-

growing shifted successively to new areas. Where no new land was available the industry has been faced with declining yields or with yields which did not keep pace with what might be expected from the introduction of higher yielding varieties and improved cultural methods. This applies even to countries where cane was rotated with green manuring crops or with fallowing. The experience of other countries is striking and contains a serious lesson which Ceylon cannot ignore.

The problem of soil depletion is complicated by two factors. First, exhaustion of the soil is a gradual process which may continue for many years before it becomes clearly evident. Secondly, restoration of soil fertility is a tedious and costly process.

Java is one of the very few cane-growing countries where soil fertility has been maintained and where the yields of cane and other crops have shown a steady increase during the past century. According to government regulations in Java, cane may occupy the same field only once in three years ; during the other two years paddy is grown during the wet season, and leguminous and other crops during the dry period. Cane growers in Java have been fully aware of the beneficial effects of a paddy crop on the subsequent cane crop. Fields where, for one reason or another, paddy cultivation was not adopted, were characterized by subnormal sugar yields which, however, rose as soon as paddy was introduced in the rotation cycle. Consequently, many plantations in Java declined to grow cane on fields which had not been under paddy during the preceding season.

Observations in the experimental fields at Polonnaruwa point in the same direction. Some of the experiments are on land in which paddy had immediately preceded cane, while others are on land where no paddy has been grown. The difference in cane development is striking. Even the soil is different in the former ; the colour is darker and the physical condition and water retaining capacity are definitely superior. The mechanism by which a paddy crop effects this remarkable amelioration is only partly understood, but the facts speak for themselves.

On the other hand sugarcane appears to benefit the subsequent paddy crop. Investigations elsewhere have indicated that the tilth of the soil is improved, possibly as a result of the intensive soil cultivation associated with cane-growing. Other factors are the deep and extensive root system, the accumulation of organic matter in the soil, and the suppression of weed development mentioned previously.

Evidence so far available seems to indicate that a rotation of sugarcane and paddy offer distinct benefits to both crops and it seems likely that the succession of dry and submerged soil conditions resulting in alternating aerobic and anaerobic activities of the soil organisms contributes to soil amelioration.

Another factor is the labour distribution. Usually, a crop requires more labour during certain periods than during others. Sugarcane requires much labour during the dry season and practically none during the wet period.

Paddy, on the contrary, has a labour peak during the wet season. It is obvious that a combination of both crops grown in rotation would provide satisfactory employment all the year round.

Finally, attention must be drawn to the use of cane tops as fodder. Experiments on the cattle farm at Polonnaruwa have shown that cane tops, viz., the top of the stem with adhering leaves, make an excellent cattle fodder whether fed green or as ensilage. An acre of cane produces 5 to 10 tons of green tops. But what seems to be more important, this fodder is available during the dry season when other fodder in the dry zone is scarce. Evidence so far indicates that one to two head of cattle can be fed from one acre of cane all the year round, either by fresh tops or by ensilaged tops.

In view of the paramount importance of paddy production for the food economy of Ceylon, it is clear that for the reasons indicated, the cultivation of sugarcane as a rotation crop with paddy will be of advantage to the food industry of the country.

By-products.—In the process of crushing, the juice flows off and the fibre—the so-called bagasse—is left. The latter is used as fuel in the furnaces of the mill thus rendering a cane sugar factory self-sufficient in this respect. Under certain conditions, not all the bagasse is needed as fuel and the balance can be used for the manufacture of useful products. Where hydro-electrical schemes provide cheap energy, much bagasse can be saved.

Bagasse is a valuable raw material for many products like building and insulating board (Celotex), card board, paper, alpha-cellulose, plastics, &c. In view of the great demand for building material in Ceylon the manufacture of Celotex or similar materials seems to be particularly attractive.

Another by-product is molasses which can be used for the production of alcohol and low-grade yeast for cattle food or for human consumption. Molasses is also directly fed to livestock, either by adding it to the drinking water or by mixing it with other feedstuffs. Its use in ensilage is rapidly increasing on account of the favourable results obtained with molasses ensilages.

Molasses is also used in the production of organic chemicals such as acetone and butanol, acetic acid, citric acid, lactic acid, and glycerine. Finally both molasses and the two other waste products, filter mud and furnace ash, make excellent fertilizers on light and medium heavy soils, especially for paddy.

Preliminary Studies on the Chemistry of Cattle Manuring on Coconut Estates

BY

M. L. M. SALGADO

MANURING by tethering cattle on coconut estates is a well-established traditional practice in Ceylon. Whether it has a sound scientific basis or not needs careful investigation. There is no doubt that it could not have gained such popularity had it not given practical results in increasing and/or maintaining yields on coconut estates.

Cattle and other livestock on coconut estates are kept with the expectation of utilizing their excreta as a source of manure for the coconut palms. While it may be true that the ideas which estate owners had entertained with regard to the value of this practice are sometimes exaggerated it would be useful to examine the scientific basis on which these practices are founded, as well as the possibilities of rationalizing these practices in the light of the results of the manurial experiments and studies on the nutrition of coconut palm.

We cannot share the views of those who, preparing a mere balance sheet of nutrients taken up by cattle, based on insufficient data and incomplete deductions, condemn cattle manuring wholesale by the disparaging remark "Robbing Peter to pay Paul".

Cattle help to transform unavailable minerals (such as potash), held up by the soil into easily assimilable plant food. Even though added fertility can normally result from purchased manures bought from outside, cattle transfer from the pasture flora on which they graze plant food, both nitrogen and potash that would not be normally available to the coconut palm and thus add to the credit side of the manurial balance sheet in the cycle of changes that take part between the plant and the soil.

In the second place, cattle may produce an actual increase in the nitrogen content of the soil. This may be effected by the action of nitrogen-fixing bacteria, such as Azotobacter, for the development of which cattle manure would be the best medium.

The legume *Desmodium triflorum* that forms the main association with close grazed grasses of coconut estates, must also be fixing nitrogen, which in turn, is made available as manure through cattle.

EXPERIMENTAL

In order to determine the amount of plant nutrients produced by cattle in the traditional method of tethering a pair of animals at night and investigating into the chemistry of cattle manuring, a special cattle shed was constructed, in which 10 animals could be tethered and the dung and urine collected separately for each animal and samples obtained for analysis.

Buffaloes.—As no records of the composition of buffaloe manure were available (except those of Phillipine carabaos) ([1]), the first series of analyses was carried out with one pair of working buffaloes that were separately tied in the cattle shed for a period of 10 consecutive nights, the animals being tied in the evening. The amount of dung and urine produced was collected separately for each animal every morning and samples taken for analysis. The results of this work is shown in Table IA and B where the volumes of urine for each day for a period of 10 nights, weights of dung and composition of both dung and urine, are separately given.

On this basis, a pair of buffaloes tied for 10 nights voided 5·14 gallons of urine containing a total nitrogen content of 0·32 lb. and a total potash content of 0·86 lb. (calculated as potassium oxide).

During this period 450 lb. of dung were produced, containing an average moisture content of 81 per cent., which has a total nitrogen content of 1·06 lb. and a total potash content of 0·31 lb. (calculated as potassium oxide).

Table II shows the average composition of faeces voided by Philippine Carabaos (Buffaloes) ([1]). The average daily yield of dung is 18·8 kg. (It may be mentioned that in this analysis, it is not known whether the dung was in contact with urine or not.) This amount presumably includes the dung voided by day and night whereas Table IA refers to amounts voided at night.

Neat cattle.—A similar experiment was conducted on a more comprehensive scale, using 5 animals, representative of the usual type of village cattle used for manuring. The selected animals were tied at 4 p.m. each day and untied at 7 a.m. the following day for a period of 7 days. Dung and urine produced during this period were collected separately for each animal, daily records being kept for every individual animal.

For sampling, 200 c.c. of urine and 400 grm. dung were used per day per animal, and this too was done in duplicate.

Moisture determinations were made on the samples daily, the analyses being done on air dry samples. These too were done in duplicate on the samples, a moisture determination also being done in conjunction with every analysis.

The complete results were summarized in Table III, composition being calculated on air-dry samples.

Tables IV and VI show the comparative manurial values of cattle manure and buffaloe manure. In Table V, results are shown, calculated on fresh excrement, in conjunction with results obtained from analyses on American ([2]), Philippine ([1]) and Nellore cattle ([3]).

On this basis, a pair of neat cattle tied for 10 nights voided 184 lb. fresh dung or 29·4 lb. of moisture-free matter; percentage of moisture being 84 per cent. (as compared with 81 per cent. for buffaloe) which gives a total—

Nitrogen value of ..	0·52 lb.
Potash value of	0·14 lb. (calculated as Potassium Oxide)
and a total Phosphoric Acid value of	0·25 lb. (calculated at P_2O_5).

The corresponding values of urine during this period are: 6·74 gallons of urine containing a total nitrogen value of 0·76 lb., and a total potash value of 0·99 lb. (calculated as potassium oxide).

DISCUSSION

An examination of these results indicate the inadequacy of manuring coconut palms by the traditional method of tethering cattle only, without adequate supplementary manures to form a balanced manure mixture. In the light of the results obtained from the manurial experiments conducted by us ([4]), ([5]) using mainly artificial manures, it should be pointed out that cattle manuring as done by the traditional method of tethering cattle for 7 to 10 nights alone supplies an inadequate amount of Potash to the palm compared to the high proportion of nitrogen (vide Table VI).

More recent data ([5]) tend to show that excess nitrogen may in fact be harmful.

The results of our manurial experiment show that, whilst nitrogen in excess of say, 0·5–0·75 lb. N. per palm, may be excessive, the corresponding amounts of potash should amount at least to 1·5 lb. K_20, if applied biennially.

In the case of lateritic soils, poor in phosphoric acid, phosphoric acid should also be supplemented to produce an adequately balanced mixture.

In most estates where cattle manuring is done, particularly the small estates, it is the usual practice to add 1 to 2 tins of ash and this should supply both the potash and phosphoric acid to form a balanced mixture. It will therefore be seen that the traditional practices have a sound scientific basis.

Where cattle manuring is done on an extensive scale, adequate supply of ash (e.g., butt-end ash and/or husk ash or kitchen ash) cannot be economically obtained. Under such conditions the addition of supplemental artificial manures in the form of Muriate of potash (at least 1 lb.) and phosphatic manure such as saphos (at least 1 to 2 lb.), as recommended in Coconut Research Scheme Leaflet No. 12, seems justified.

In the paper entitled "The Possibilities of Ley Farming and Alternate Husbandry on Coconut Estates" ([6]) the writer has discussed at length the question of Animal Husbandry on Coconut Estates. It is well known that cattle (and this is particularly true of buffaloes with their active digestive system adapted to assimilate coarse fodders and weeds, such as illuk) help

to transform vegetable matter into assimilable plant food far more quickly than by the natural process of decay when such materials are turned into the soil. On the basis of a manurial balance sheet, using the animal as a factory for producing easily assimilable organic matter, there would be a quick turn-over of both the Nitrogen and the mineral matter that would not, under normal conditions, be easily available to the root system of the coconut palm.

It is not proposed to explain in detail this aspect of the subject. Suffice it to say that the traditional method of tethering cattle, which no doubt could be improved in a variety of ways, has a sound basis of scientific confirmation.

We are aware of estates where reasonable yields have been maintained by cattle manuring alone, using husk and butt-end ash on practical lines.

There are many aspects of this problem which should be investigated more closely, and as further light is thrown in the course of time, it should be possible to develop this traditional system of manuring on modern lines. We may, however, conclude that cattle (and perhaps other forms of livestock too, like goats, pigs and poultry, &c.) should form the basis for a system of scientific mixed farming on coconut estates, in order to maintain the fertility of soil.

From a system of coconut monoculture, a scientific development of animal husbandry (mixed farming) should therefore be the key to a well developed system that must break away from traditional method of cattle manuring as done on coconut estates.

ACKNOWLEDGMENTS

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TABLE IA

Composition and Volume of Buffalo Urine

Night No.	Volume of Urine in c.c.		Grm. N. per 100 c.c.		Total N. in grm.		K_2O grm/100 c.c.		Total K_2O grm.	
	Animal 1	Animal 2	Animal 1	Animal 2	Animal 1	Animal 2	Animal 1	Animal 2	Animal 1	Animal 2
1	—	720	—	0·34	—	2·45	·8	—	—	—
2	840	2,620	0·85	0·53	7·14	13·89	1·98	1·10	16·63	28·82
3	270	1,060	0·78	0·55	2·11	5·83	2·12	1·25	5·72	13·25
4	950	1,000	0·60	0·59	5·70	5·90	—	—	—	—
5	1,600	2,490	0·83	0·67	13·28	16·68	—	—	—	—
6	150	410	0·73	0·60	1·10	2·46	1·68	1·48	2·52	6·07
7	1,750	1,110	0·76	0·58	13·30	6·44	1·80	1·55	31·50	17·20
8	2,270	1,650	0·70	0·56	15·89	9·24	2·03	1·75	46·08	28·80
9	470	2,010	0·64	0·50	3·01	10·05	1·90	1·82	8·93	36·58
10	240	1,770	0·54	0·50	1·30	8·85	1·51	1·58	3·62	27·97
Total	8,540	14,840			62·83	81·79			115·00	158·77
					For 10 days Mean—0·16 lb.				For 10 days Mean—0·43 lb.	

TABLE IB

Composition and Weights of Buffalo Dung

Night No.	Weight of dung in lbs.		Moisture per cent. in fresh dung		Nitrogen per cent. in Air Dry material		Potash per cent. in Air Dry material	
	1	2	1	2	1	2	1	2
1	24·90	18·67	79·9	81·4	0·72	1·37	·275	·295
2	24·01	21·10	80·0	79·8	1·11	1·12	·416	·295
3	21·31	16·76	80·0	79·0	1·15	1·12	·525	·244
4	23·40	22·64	80·7	80·8	1·21	1·25	·436	·279
5	18·67	23·96	80·8	81·2	1·28	1·43	·350	·329
6	22·19	27·26	80·7	81·9	1·27	1·29	·379	·331
7	25·05	25·28	81·5	82·1	1·15	1·16	·344	·342
8	28·33	23·74	82·8	82·6	1·27	1·17	·248	·374
9	25·66	20·25	83·2	83·4	1·20	0·98	·230	·387
10	22·11	13·40	81·8	81·0	1·16	1·23	·294	·515
Total	235·64	21·31			11·52	12·12	3·497	3·291
Mean/day	22 lb.		81·2		1·15	1·21	0·350	0·329

TABLE II

The Average Chemical Composition of Faeces of Philippine Carabaos

Animal No.	*Average daily yield kg.**	H_2O	*N.*	P_2O_5	K_2O	*CaO*
9	19·9	83·1	0·22	0·65	0·17	0·20
64	19·8	83·9	0·26	0·53	0·17	0·13
83	16·9	82·4	0·27	0·76	0·11	0·18
89	15·3	82·1	0·33	0·61	0·13	0·17
122	22·0	82·6	0·28	0·58	0·14	0·19
Average	18·8	82·9	0·27	0·63	0·14	0·17

* 1 Kg. = 2·2 lb.

TABLE III

Composition of Cattle Manure

Animal No.	*Production per animal per night*		*Composition of Excrement of Air-dry samples*							
			Nitrogen		*Phosphoric Acid*		*Potash*		*Moisture on dry sample Dung per cent.*	*Total moisture in Dung per cent*
	Fresh Dung A	*Urine c.c. B*	*Dung A*	*Urine B*	*Dung A*	*Urine B*	*Dung A*	*Urine B*		
1	7·6	1,460	1·52	1·21	0·83	T	0·25	1·04	9·8	83·9
2	6·7	1,752	1·50	1·03	0·76	R	0·29	1·22	9·2	81·3
3	6·8	813	1·43	1·21	0·75	A	0·42	1·76	10·3	83·1
4	11·8	1,260	1·83	1·10	0·65	C	0·43	1·83	9·2	84·9
5	12·8	2,392	1·81	1·12	0·69	E	0·75	1·61	8·9	86·0
Average	9·2	1,535	1·62	1·13	0·74	—	0·43	1·49	9·5	83·8

TABLE IV

Showing the comparative Manurial Values of Cattle Manure and Buffalo Manure in terms of the amount of excrement per animal per night

	Neat Cattle	*Buffaloes*
Urine—		
1. Volume per night	1·535 c.c.	1,219 c.c.
2. Total Nitrogen per night	17·23 grm. or 0·038 lb.	0·016 lb.
Percentage Nitrogen	1·13	0·62
3. Total Phosphoric Acid per night	Trace	Trace
Percentage Phosphoric acid		
4. Total Potash per night	22·48 grm. or 0·050 lb.	0·043 lb.
Percentage Potash	1·49	1·68
Dung—		
1. Amount voided per night	9·2 lb.	22·5 lb.
2. Total Nitrogen per night	0·026 lb.	0·053 lb.
Percentage Nitrogen	1·62	1·18
3. Total Phosphoric Acid per night	0·012 lb.	
Percentage Phosphoric Acid	0·74	—
4. Total Potash per night	0·007 lb.	0·015 lb.
Percentage Potash	0·43	0·34

TABLE V

Showing the Composition of Fresh Excrement of Ceylon Neat Cattle, Amercian Cattle, Nellore and Philippine Cattle

Animal No. (Ceylon)	*Weight of Dung voided per night (lb.)*	*Dry Matter Percentage*	*Nitrogen Percentage*	*Phosphoric acid per centage*	*Potash percentage*
1	7·6	16·1	0·27	0·16	0·04
2	6·7	18·7	0·31	0·16	0·06
3	6·8	16·9	0·26	0·13	0·08
4	11·8	15·1	0·32	0·11	0·07
5	12·8	14·0	0·28	0·11	0·12
Average	9·2	16·1	0·28	0·13	0·07
American cattle	52·0 per day	16·2	0·22	0·21	0·16
Nellore cattle (cows)	11·6 kg. per day*	17·5	0·28	0·30	0·15
Philippine cattle (cows)	11·4 kg. per day*	16·2	0·27	0·41	0·20

* Kg. = 2·2 lb.

TABLE VI

Total manurial values of Cattle Manure and Buffaloe Manure expressed in lb. per animal per night

Manurial Constituents	*Total in lb. (per night) per animal*	*Total in lb. 10 nights per pair*
Buffaloe Manure—		
1. Total Nitrogen in Dung and Urine	0·069 lb.	1·38
2. Total Phosphoric acid in Dung and Urine	not determined	—
3. Total Potash in Dung and Urine	0·058 lb.	1·16
Cattle Manure Neat—		
1. Total Nitrogen in Dung and Urine	0·064 lb.	1·28
2. Total Phosphoric Acid in Dung and Urine	0·012 lb.	·24
3. Total Potash in Dung and Urine	0·057	1·14

Notes on Legumes II

BY

W. R. C. PAUL

IN this paper, further notes are presented on legumes which have mostly been under trial at the Experiment Station, Peradeniya. Some of these are new and others early introductions or indigenous species which have hitherto been either of restricted use or of little economic value.

Tropical legumes far outnumber those of temperate regions though they have not been utilised so intensively. There is need for more investigations into the possibilities of the numerous wild legumes that occur in various parts of the tropics for use as ground covers, companion crops in mixtures with non-legumes, components of grass leys and forage crops. Much work remains to be done in selecting and breeding improved strains.

Considerable progress could be made if tropical countries would carry out trials with the promising legumes growing in the same agro-climatic zone of others where such legumes are not already studied. In Ceylon, there have been several successful introductions in the past. Amongst ground covers for plantation crops, especially rubber, mention may be made of the following which were introduced from about 1922 onwards :—

First, there was *Dolichos hosei* Craib formerly known as *Vigna oligosperma* Backer, then *Centrosema pubescens* Benth., *Calopogonium mucunoides Desv.*, *Pueraria phaseoloides* Benth., *Indigofera endecaphylla* Jacq. and lastly *Desmodium ovalifolium* Wall. Of the more recent introductions *Stylosanthese gracilis* HB & K as a pasture legume and velvet beans *Stizolobium aterrimum* Piper and Tracy as a drought resistant annual ground cover for improving the fertility of arable land in the dry zone are outstanding.

The legumes in these notes are discussed under their characteristic habits of growth :—

(a) *Prostrate and semi prostrate plants*—(i) *Psophocarpus palustris* Desv. (-*P. longepedunculatus* Hassk.). This species made its appearance in 1950 as a few stray plants in one of the observation plots in which *Desmodium gyroides* D. C. was planted in May 1949 from seed. It was introduced from Java in 1936 and the seed probably remained dormant for a few years during the period that there was no record of its cultivation. From these plants, seed was collected and sown in an observation plot in 1950. A good cover was formed in about 4 months' time and even after a period of 2 years it showed no signs of dying back. It produces blue flowers and angular

pods 1½–2 in. long with serrated edges on the wings. The seeds are black and measure 0·50–0·75 cm. long and 0·5 cm. wide. This legume may prove of value as a ground cover for perennial crops and as a component of pastures. It originated from tropical Africa where the young pods are used as a vegetable. It is, unfortunately, susceptible to nematode attack.

(ii) *Glycine javanica* Linn. Although a native of tropical Africa and Asia, this legume does not commonly occur in this Island. In Southern Rhodesia it is known as the Rhodesian kudzu vine. A sample of seed was received from Mr. J. L. Schofield, Pasture Research Officer, Kenya, where it is common in grassland and was sown in an observation plot on October 23, 1950. Flowering commenced on January 16, 1951, and pod development soon followed. By February 15, an excellent cover was formed. The pods are black, about 1 in. long and 1/8 in. wide, slightly hairy each containing about 3–5 brown seeds per pod. As flowering and seed production apparently only take place in January, rooted cuttings were planted in new beds and grew successfully. This legume like *Psophocarpus palustris* forms a vigorous cover which stands up well to dry weather at the Experiment Station, Peradeniya. Bogdan (i) has recorded this species to be one of the most palatable, of those tested by him, to cattle and sheep. There is every possibility of its being a useful perennial pasture legume in Ceylon.

(iii) *Indigofera enneaphylla* Linn. and *Tephrosia pumila* Linn. These legumes are found growing in close association with grasses in gardens and paddocks in the dry zone and are subject to close and regular grazing by stock. The former which occurs to a greater extent in the northern part of the Island has a spreading habit and a thick rootstock and is similar in general appearance to *I. endecaphylla* Jacq. one of the recommended legumes for pastures in the wet lowlands, though its leaves and flowers are smaller. Chandrasekera and Sunderaj (2) report that in South India 'it enriches the value of the pastures and that cattle relish it'. Seed of the South India type was obtained and sown in an observation plot. Growth was slow and under wet zone conditions it did not prove to be a sufficiently vigorous legume for inclusion in pastures. *Tephrosia pumila* has a similar habit of growth but possesses small white or pink flowers and flat pods. Observations in the dry zone show that these two legumes form useful components of pastures in that zone though during the dry season they die down but come up again in the following wet season.

(iv) *Alysicarpus rugosus* D. C. This is an indigenous species, seed of which was collected from the north (Jaffna area). It was sown in observation plots both at the Agricultural Station, Horana, and later at the Experiment Station, Peradeniya. It proved to be a quick growing annual with a semi-erect habit. The leaves which are 4·3–4·8 cm. long and 2·9–3·8 cm. wide are much larger than those of the common *A. vaginalis* D. C. (Singh. *Aswenna* Tamil *kuthiravali*), a good legume for pastures of the wet lowland regions. The pods are 4·5 cm. long and 2·5 cm. wide with 5–6 seeded joints. The plants flower in 2 months and die self sown seed. The collection of the pods can be readily undertaken and the seed when sown germinates well. For early pastures, this is a useful legume in the dry zone.

(b) *Erect bush plants.*—(i) *Desmodium distortum* Aubl. Macbride. A seed sample was received in 1950 from Guatemala through the courtesy of the U. S. Department of Agriculture Office of Foreign Agricultural Relations and the U. S. Embassy in Colombo. This is a wild plant in Central America but was reported to be of value in feeding poultry and specially young chicks by the U. S. Department of Agriculture Visiting Mission to Guatemala.

The seed that was received germinated well in about 3 days' time. The first 5 to 6 leaves are single and oval in shape while the later leaves are trifoliate, elliptic ovate to ovate in shape, 5–9 cm. long, obtuse at the apex and covered with silica hairs. The purple flowers are borne on paniculate inflorescences. The pods are 2 cm. long and 0·20 to 0·25 cm. wide and contain 4/6 seeds per pod. The plants are perennial, herbaceous and slightly suffrutescent at the base. Flowering and pod formation take place between October and March. The plants grow to a height of 6 to 8 ft., but they can be repeatedly cut back to a height of about 1 ft., from the base from which new shoots arise. The loppings can be fed direct to cattle and goats and also to poultry after finely chopping. They can also be dried and converted into a hay meal by grinding for feeding poultry in a mash with other rations. The following analysis of the leafy tops of this legume and of lucerne for comparison were carried out at the Bureau of Animal Industry, Chemistry Laboratory, Manila (3) :—

	D. distortum		*Lucerne*	
	Fresh *Per cent.*	*Dry* *Per cent.*	*Fresh* *Per cent.*	*Dry* *Per cent.*
Moisture ..	77·38..	0·00..	76·05..	0·00
Crude protein ..	5·37..	23·73..	5·61..	23·44
Ether extract ..	0·81..	3·59..	0·58..	2·42
Crude fibre ..	4·37..	19·33..	6·56..	27·38
N. free extract ..	9·96..	44·02..	9·50..	39·66
Ash ..	2·11..	9·33..	1·70	7·10

D. distortum which was introduced from Guatemala in 1950 in the Philippines by Dr. J. V. Hepler of the U. S. Department of Agriculture is considered to be an ideal forage for goats as intestinal worm infection which is serious in that country is reduced to a minimum when the goats brouse on the shrub (3). This legume has been grown successfully at Peradeniya and seed has now been sent to other areas for trial.

(ii) *Cajanus cajan* (Linn.) Millsp. Pigeon pea or Toor dhal. The attempts that were made in the past to introduce the cultivation of this pulse in Ceylon resulted in varieties from abroad developing an excess of vegetative growth with poor seeding when planted here. These tree dhals were hitherto of little value. Within the last two years a few varieties from India have proved successful and types which produce small plants with heavy seeding have been isolated. The cultivation of seed dhal types is thus no longer a difficult problem in Ceylon. Investigations with tree dhal types in improving soil fertility are in progress at the Dry Farming Research Station at Maha Illuppalama.

SUMMARY

Two legumes—*Psophocarpus palustris* Desv. and *Glycine javanica* Linn.—give promise of being good ground covers and legume components of pastures and for the wet lowland zone. The former was introduced in 1936 from Indonesia (Java) though it originated from tropical Africa. The latter is an indigenous species though seed of a strain grown in East Africa received in 1950 is doing well.

Three legumes—*Indigofera enneaphylla* Linn., *Tephrosia pumila* Linn. and *Alysicarpus rugosus* D. C., are indigenous to the dry lowland zone of Ceylon. They grow in close association with grass and stand up well to grazing.

Desmodium distortum Aubl. Macbride is a forage legume which grows wild in Central America. It is reputed to be of value in feeding poultry and especially chicks. Seed was received in 1950 from Guatemala and the plants thus raised have come up well and seed satisfactorily. They are useful for goats to brouse on.

After many attempts to introduce the cultivation of pigeon pea in this Island, a few varieties have been found which seed satisfactorily.

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Banana Cultivation in Australia

BY

A. V. RICHARDS

BANANAS are grown commercially under subtropical conditions in Australia inspite of Bunchy Top disease which was accidentally introduced in 1913 with banana suckers from Fiji, and this remarkable achievement is claimed as a " triumph of Science ". In 1950 there were 26,376 acres in bearing in New South Wales, 12,285 in Queensland, and 242 in West Australia making a total of 38,903 bearing acres.

The production in West Australia is inadequate to meet local requirements, and is centred at Carnarvon on the Gascoyne river from the bed of which water is pumped for irrigation in summer.

Queensland was once known as " Bananaland " since it was the principal banana producing State, but it lost this distinction about 16 years ago to New South Wales which now produces 3½ bushel cases to every one grown in Queensland, the total production being 2,307,500 cases as against 705,000 cases in a record Australian production of 3,093,000 cases in 1948–49.

The dwarf Cavendish variety of banana, which is not unlike the local *Binkehel*, was grown in the Tweed district of New South Wales as far back as 1894, and production increased inspite of the incidence of Bunchy Top disease, but by 1912 when a peak production of 460,000 cases was reached the disease spread rapidly in epidemic form, and in three years almost completely wiped out the banana industry.

The plight of the growers was so desperate that in May 1924 a Bunchy Top Investigation Committee was appointed by the Commonwealth, New South Wales and Queensland Governments to investigate and report on the Bunchy Top disease, and it presented its report in 1927.

Dr. C. J. Magee, (1927) Chief Plant Pathologist of the New South Wales Department of Agriculture, who was one of the three members of the Committee, showed that the disease was caused by a virus carried by the banana aphid *Pentalonia nigronervosa*. Quarantine areas were proclaimed, and with the active co-operation of Growers Co-operatives such as the Banana Growers' Federation of New South Wales and the Committee of Direction of Fruit Marketing (C. O. D.) of Queensland the industry was rehabilitated within a few years.

BANANA PRODUCTION IN NEW SOUTH WALES AND QUEENSLAND

The banana industry in New South Wales is localised in the North-East corner of the State, the chief centres of production being on the Tweed, Richmond, and Brunswick rivers, and at Coffs Harbour. In 1950 there were 7,708 bearing acres in the Tweed district, 6,822 in Brunswick, 5,618 in Richmond and 6,226 in the Bunchy Top free areas at Coffs Harbour and Nambucca. The total number of growers was 6,558 of which 4,303 had one acre or more under bananas, and 2,255 less than one acre. Many of the plantations are 5 acres in extent which is an economic size for a family to manage.

In Queensland the banana plantations are scattered over a wider area, the chief centres of production being near the border in the South coast, the Metropolitan area round Brisbane, the Near North Coast 80 miles north of Brisbane and tropical North Queensland about 1,000 miles north of Brisbane. No Bunchy Top disease is present beyond Bundaberg 100 miles north of Brisbane, but in North Queensland production is limited by Cercospora leaf spot disease.

Climate and Soil.—Bananas are grown in favourable localities along the coast where the climate is subtropical with a fairly well distributed rainfall, but further inland it gets quite dry and cold during winter. Even in the southern coastal areas the plantations are generally located on hillsides at about 1,200 feet. Above this elevation there is danger of chilling, and below it in the valleys frost damage is likely to be serious.

Bananas make the best growth on soils of volcanic origin which are well drained, deep and fertile. They also grow well on the rich alluvial soils of the river flats, but frost hazard is great in these localities. As much of the available good land in the North Coast district of New South Wales has at one time or other been planted to banana the possibility of growing it on relatively poor soils of the open forest country is being explored. One grower has grown bananas successfully on such soils using pig manure.

Varieties.—The principal variety of banana grown is the dwarf Cavendish (Fig 1), but the semi-tall variety, William's Hybrid, which originated as a budsport from Cavendish in Coffs Harbour is fast becoming popular because of its large bunches and excellent flavour of the fruit. It grows better than Cavendish at higher elevations.

The Mons Marie which originated as a similar semi-tall budsport from Cavendish at Budrum, about 80 miles north of Brisbane, is a popular variety in Queensland. It is difficult to tell the difference between these two budsports of Cavendish. In one rare instance a dwarf Cavendish type budsport was found to originate from William's Hybrid at the plantation of Messrs. Spinaze Brothers at Tulleray, near Lismore, New South Wales.

The Manila or Lady Finger which is not unlike the local *Puwalu* is grown as a wind break round banana plantations in New South Wales, and the bunches are seldom harvested ; but in the Metropolitan area round Brisbane and in the Near North Coast of Queensland this variety is grown extensively for its fruit which is sold in bunches in the Brisbane market. In the case of other varieties the individual fruits or "fingers" are packed for the market in bushel cases each measuring 12 in. by 12 in. by 21 in. internally.

FIG. 1.—CAVENDISH BANANAS AT DURANBAH EXPERIMENT PLOT, NEW SOUTH WALES

The Lady Finger variety is threatened with extinction by the Panama disease caused by the soil borne fungus *Fusarium oxysporum* Fr. The disease wiped out the Sugar or *Kolikuttu* variety which was once very popular in Queensland.

Occasional plantings of Gros Michel are found in the tropical North Queensland, but being a very tall variety it requires sheltered situations. The bunches and individual fruits are very large. Ducassas is another tall variety under trial. Its fruits are covered with a whitish bloom like that of the ash plantain, and the flavour is not superior.

Other varieties grown as a curiosity are the Colombo banana or *Embul honderawala*, producing small fruits of poor quality, the *Anamalu*, incorrectly called *Embul honderawala*, which makes tall weak growth, but considered promising because of the large size and sweet flavour of the fruit, the Red Rajah (*Rathambala*) and the cooking variety called " plantain " (*mondan*) for both of which there is no demand.

Planting.—It has been the practice to plant bananas in rows running up and down the hill sides, but growers are beginning to appreciate the advantages of contour planting recommended by the Departments of Agriculture. A popular spacing for Cavendish is 10 ft. between contour rows, and 6 ft. in the row, but some even plant as close as 5 ft. by 5 ft. allowing only one sucker per stool on the side up the hill.

The best planting material is the " sword sucker " which has a well developed corm and small narrow leaves, but when it is in short supply ' bits ' or pieces of the old corm, each with a single bud and weighing about 3 lb. are planted and covered with soil to a depth of at least 4 inches in holes 12 in. by 12 in. by 18 in.

The planting material is cured before planting by trimming all the roots and exposing the cut surfaces to sunlight for a few days. If the ' bits ' are too small to be exposed to the sun they are treated with fungicidal disinfectant.

Manuring.—Bananas are given heavy applications of fertilisers. A fertiliser mixture consisting of 10 parts nitrogen, 8 parts phosphoric acid and 10 parts potash is given in September (early spring) January and March at the rate of about 2 lb. per stool. Some growers use blood and bone manure at the rate of 8 lb. per stool in three applications in August, Junuary and March, and in addition sulphate of Ammonia at the rate of 2 oz. per stool every six weeks.

Cultivation.—On young plantations vetches or velvet beans are grown as green manure during winter, and turned into the soil or pulled and left as a mulch round the stools. The hillside plantations are " chipped " or hoed by hand in summer because of the difficulty of using mechanically operated implements, but on level land rotary hoes are used in the early years when the plants are small.

Desuckering.—Not more than one or two suckers are allowed per stool on the side up the hill to ensure deep rooting. The growing points of the unwanted suckers are gouged out with a special implement called the banana desuckering gouge which is made of spring steel. Fixed to its handle is a slightly concave pointed blade 9 in. long with sharp edges. The point of the blade is inserted at an angle of 30° from the vertical just inside the outer edge of the base of the unwanted sucker, and with a semi circular turn to the left and then to the right the growing point of the sucker is removed with the piece of a corm in the shape of an inverted cone. This implement is not used for digging out suckers for planting.

Spraying.—A spray mixture consisting of Cuprox (copper oxychloride) in the following proportions is used for spraying in December, January, February and March against Cercospora leaf spot disease caused by the fungus *Cercospora musae*, which in severe cases kills the leaves prematurely and reduces the size of the bunches.

1½ lb.	Cuprox
11·4	fluid ounces colloidal sulphur
3 oz.	"Wet Set" (wetting agent)
40 gallons	Water

If rust thrip is troublesome 13 oz. of 40 per cent. dispersable D. D. T. is added to the spray mixture. In some plantations on steep hillsides 44-gallon drums are placed in convenient positions to collect rain water for making the spray mixture, and a portable engine pump with a good length of hose is used for spraying (Fig. 2).

Irrigation.—Hardly any irrigation is given to bananas in the North Coast district of New South Wales where the rainfall is fairly well distributed, but in parts of Queensland bananas are given spray or furrow irrigation during the dry months.

Harvesting.—In a five-acre plantation bunches are harvested nearly every week except in the winter months when they are harvested about once a fortnight. They take 4 to 6 months to mature according to the season, the winter fruit being slow to mature, and when produced in November has deformed ends known as "Cigar ends".

The bunches are harvested by hand and transported to the packing sheds. On hillside plantations wire shoots or "flying foxes" are used for transporting the bunches from great heights. Many of them are ingenious contrivances devised by the grower himself. The bunches are harvested before they are quite mature, and any bunch in which a fruit or two has ripened is not used for packing. The bunch is generally ready for harvesting when nearly all the flowers in the "bell" or male inflorescence have opened. In New South Wales quarantine regulations prohibit the removal of the bell till the bunch is harvested, since it is often possible to pick out Bunchy Top symptoms in the bracts of the bell though they may not be visible on the other parts of the plant. But in Queensland there is no such restriction.

Packing.—The Cavendish, William's Hybrid, and Mons Marie are packed singly as "fingers" in bushel cases (Fig 3.). For this purpose the bunch

FIG. 2.—SPRAYING BANANAS AGAINST CERCOSPORA LEAF SPOT DISEASE

FIG. 3.—PACKING CAVENDISH BANANAS IN BOXES

is first cut into "hands," and the individual fruits are then broken off from each "hand" and packed. The Lady Finger variety is not packed singly as "fingers", but sold as bunches which are then cut into "hands" or "combs" by the retailer.

All packed banana cases are required by law to be dipped in a fungicide shirlan A. G. (25 per cent. suspension of salicylanide) for disinfection against squirter disease caused by the fungus *Nigrospora sphaerica*. Fruit attacked by this disease develops a dark watery rot as it ripens. A simple but very delicate chemical test has been perfected to determine rapidly whether a case of bananas picked at random from a railway wagon has been Shirlan treated or not. Shirlan treatment is compulsory for all fruit packed for sale between 1st May and 30th November.

Marketing.—Nearly all growers in New South Wales consign their fruit to their Commission Agents in the principal markets in the capital cities through the Banana Growers' Federation Co-operative Ltd., which was formed in 1933 essentially as a transport and marketing organization. But in Queensland the Committee of Direction of Fruit Marketing (C. O. D.) which is a growers' Co-operative handles the transport and sale of most of the fruit produced there. They have in the principal markets ripening rooms where the fruit is treated with ethylene, acelytene, or even coalgas at a temperature of about 60° F.

Bunchy Top Control.—In New South Wales the Bunchy Top control work is carried out by the Banana Growers' Disease Control and Development Co-operative Ltd., which is a subsidiary of the Banana Growers' Federation, formed as a non-profit organization with a nominal capital of £A5. But it spends about £A25,000 yearly on the Bunchy Top control campaign. This amount is collected as a levy on every banana case sent to the market. The company employs Bunchy Top eradication gangs whose work is supervised by the Banana Inspectors of the New South Wales Department of Agriculture.

There are about 13 gangs, each consisting of a foreman and three men, of whom one is a probationer getting a lower wage than the others whose present basic wage amounts to over £A10 each for a 40-hour week of 5 working days. Their work is supervised by 8 inspectors in charge of the 17 zones into which the entire banana producing area is divided.

When a case of Bunchy Top is detected the whole of the infected stool is sprayed with crude kerosene so that the throat of the pseudo stem and the small suckers round the bottom of the stool are well soaked. Each leaf is then sprayed on both sides and stripped until the whole stool is flat on the ground. The purpose of this is to kill all the infected aphids before they carry the virus to the neighbouring healthy plants. The foreman indicates the position of the diseased stool in a rough plan which he leaves in the packing shed or some conspicuous place where the grower could see. It is then the responsibility of the growers to dig out and destroy the diseased corm and spray the neighbouring plants with Nicotine Sulphate at the rate of ½ oz. to a gallon, or 3 per cent. solution of D. D. T.

The men are clever at detecting Bunchy Top symptoms in the very early stages before the bunching or rosetting of the leaves takes place. A

practised eye can easily detect the broken, dark green streaks that run along the finer veins of the diseased leaf or bract. The chief aim is to spot the diseased plant quickly and destroy the infected aphids before they are carried by wind to the neighbouring plants. The gang inspects each plantation by turn covering about 8 acres per man per day. When a man inspects 6 rows at a time it is called " wide survey ", 4 rows—" survey ", 2 rows—" close survey " 1 row—" stool to stool ", and in bad cases of Bunchy Top infection " leaf to leaf " inspection is carried out frequently.

No Bunchy Top eradication gangs are employed in Queensland, but it is the responsibility of the grower to report cases of Bunchy Top to the local fruit inspector and destroy all infected stools.

No planting of bananas is allowed without a permit from the local Banana Inspector. The supplier must also apply for a permit to the Banana Inspector in the area where the suckers are to be removed for planting, and the two inspectors check up and decide on the advisability of planting.

Destruction of Old Banana Plantations.—The local Banana Inspector may give permission to destroy old banana plantations by running cattle, in which case the stools must be cut down at ground level, and at least 5 or 6 head of cattle per acre must be penned on the area. But most growers now prefer to use hormones for the destruction of old banana plantations since it avoids the necessity to employ labour to dig out every stool. The method is very simple and consists in injecting one per cent. solution of 2·4 D or M. C. P. A. with an injector into the centre of the pseudo stem at a height of about 2 feet from the ground. Within a few days the pseudo stem is shattered and the plant collapses to the ground. The young suckers which arise subsequently from the base are destroyed by putting a few drops of the hormone into the throat of each plant, or spraying with ·2 per cent. of the hormone spray mixture.

This method of destruction by hormones is *not* allowed to be used for plants affected by Bunchy Top disease since regrowth of diseased suckers takes place and the infected aphids are not checked from carrying the disease to the neighbouring healthy plants.

Pests.—The Banana Beetle Borer (*Cosmopolites sordidus*) is a troublesome pest which sometimes causes serious damage. It is controlled by trapping with poisoned baits. The corm of the old pseudo stem is cut transversely at the base and is replaced after dusting the cut surfaces liberally with D. D. T. powder. The pseudo stem itself is chopped up immediately after the bunch is harvested and spread out to dry.

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Premunition of Cattle against Tick Fever

BY

S. A. SINNIAH

TICK fever is one of the most fatal diseases to which cattle of European breeds are exposed when they are imported to Ceylon, and this disease has been the cause of considerable losses in the past. The progeny of these animals if born and bred in upcountry where tick infection is not heavy also develop the disease and very often die when moved to lower elevations.

The progress of science has produced many potent remedies for the successful treatment of the disease when diagnosed early. The object of this article is to demonstrate the value of a preventive method known as premunition and to describe the technique of carrying it out.

Premunition of cattle against tick fever is carried out by the inoculation of blood drawn from known carriers of Babesia bigemina and Anaplasma marginale to susceptible animals.

The dose per animal is 5 c.c. to 20 c.c. of citrated blood given subcutaneously soon after bleeding, or at any rate not kept longer than forty-eight hours. Imported cattle should not be given more than 5 c.c. but locally bred cattle can tolerate 20 c.c.

The method of bleeding the carriers is extremely simple. The animal is secured in a trevis or cast and the blood is drawn from the jugular vein into sterilized bleeding flasks containing freshly prepared five per cent. sodium citrate solution. The proportion of blood is fifteen parts to one part of the solution. An animal can be bled with safety up to 5 c.c. per pound body weight, and the bleeding can be repeated after an interval of one week. As these carriers are to be kept for several years, during which period the blood can be used to immunize susceptible cattle, only the required quantity of blood to be used at a time is drawn and never such quantity as will impair their general health. As no preservative of any kind can be used, very great care must be taken to exclude the possibility of contamination.

While undergoing the process of immunization, inoculated cattle should be kept free from natural infection, by housing them in a tick-free shed. The animals should also be well cared for and protected from exposure to extreme heat or cold, and wind and rain.

The immunity becomes established only when the animal shows a reaction as a result of the inoculation ; but this reaction may be so mild in some cases that it is liable to escape notice unless the animal is kept under strict observation and its temperature taken regularly. If a reaction fails to develop a second inoculation is recommended. Sometimes it may be advisable to inoculate animals already premunized, with a local strain of virus if they are to be introduced into an area infected with a particularly virulent strain of Babesia or Anaplasma. Should a severe reaction be set up at any stage, indicated by rise of temperature above 105 degrees F. without tendency to drop within forty-eight hours, it can be controlled by means of any one of the drugs used in the treatment of tick fever. Babesan, Acaprin, Piroparv, and Acriflavin (Euflavin) have helped in controlling severe reaction to *Babesia bigemina*. Paludrine lactate and N. A. B. can be used to control reaction to Anaplasma marginale. The same dose as that used for treatment or slightly less, produces satisfactory results and does not affect the degree of immunity conferred. Young animals below one year do not react severely. When premunition is carried out as a routine practice in a farm, a dose can be given when the calves are reaching adult age. Single inoculation of 10 c. c. blood when they are one year old has proved satisfactory.

When imported cows heavy in calf have to be immunized, there is the fear of the animal aborting due to severe reaction. This is overcome by subjecting the blood drawn from the carriers to refrigeration before inoculation, for a period varying from several hours to a few days depending upon the virulence of the organisms. This may produce a mild reaction or no reaction in certain cases. In exceptional cases if the reaction is severe the animals should be treated with one of the drugs already mentioned and the temperature should not be allowed to rise above 105 degrees F. Fifteen to twenty days after inoculation with refrigerated blood, a dose of fresh blood should be given and the reaction watched for at least twenty-one days. If the cow is very near calving it is best to keep her under tick free conditions, and take up immunization two weeks to one month after she drops the calf. The yield of milk will be decreased temporarily.

For all practical purposes the blood containing the two organisms, Babesia bigemina and Anaplasma marginale, can be given together, as the incubation period for piroplasmosis is shorter than that for anaplasmosis and reaction to the former subsides before the reaction to the latter commences. With careful observation, regular recording of temperature, and microscopic examination of blood smears during reaction, the process of premunization can be carried through with absolute safety. The technique described has been found quite satisfactory for the strain of organisms found in Ceylon.

In Brazil, premunization against combined piroplasmosis and anaplasmosis is practised with blood from a carrier animal that has been kept tick-free for a year. Three doses of 10 c.c. each, are given at fifteen to twenty day intervals. The first is stored for fifteen days in a refrigerater before use, the second dose for twelve days, and the third dose consists of fresh blood.

The great advantage of this preventive measure, is that of producing a mild form of disease under controlled conditions with precise knowledge

of its course, and of conferring a degree of immunity which lasts several years. When premunition is carried out, the same degree of reaction is not noticed in all the animals, owing to individual variability in resistance. Some react very mildly, some moderately, some rather severely and some show no signs of reaction. The reaction to Babesia bigemina commences between the seventh and the ninth day after inoculation; in rare cases it is delayed. In the case of Anaplasma marginale there may be a reaction after the twentieth day or it may pass unnoticed.

For a comparative study of the nature of the reaction temperature records were maintained for cattle treated after natural infection and for cattle that were premunized. These are presented in the form of graphs. The important point to note is that when premunition is carried out the temperature drops rapidly to normal without much disturbance in general health, while in the case of natural infection the temperature fluctuates for a considerable period and the animal also becomes debilitated.

The methods used for the selection of a natural carrier of tick fever and the development and maintenance of carriers when natural carriers are not available, will be described in a subsequent paper.

ACKNOWLEDGMENTS

1. When Dr. R. Daubney, Director of Veterinary Services, Veterinary Research Laboratory, Kabette, came to Ceylon in 1945 to advise the Ceylon Government on veterinary matters, he suggested that we should carry out immunization of cattle against tick fever to prevent heavy losses among the imported cattle. Action was taken on his suggestion by the Department of Agriculture and three vaccine strain carriers were obtained from the same laboratory according to arrangements made by him.

The writer acknowledges with thanks the valuable information and aid given by Dr. Daubney in carrying out this work.

2. Mr. G. W. Sturgess, Government Veterinary Surgeon, in his administration report for 1928, stressed the value of immunizing susceptible cattle before they are taken into endemic areas. Mr. M. Crawford, Deputy Government Veterinary Surgeon, carried out experiments on milch cattle purchased from upcountry. The writer had the opportunity of assisting him in the above work.

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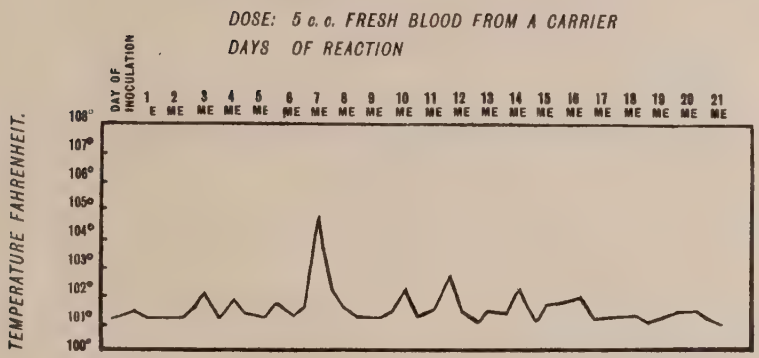
TEMPERATURE RECORD

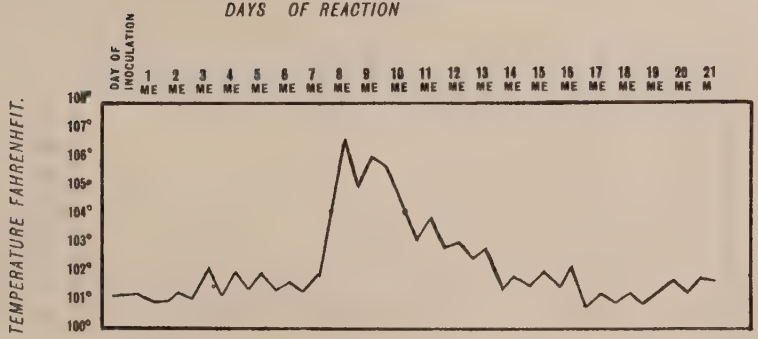
PREMUNITION REACTION

IMPORTED SHORT HORN HEIFER



NOTE:- Reaction moderate. Temperature came down to normal without any treatment.

IMPORTED SHORT HORN HEIFER



NOTE:- Reaction rather severe. Babesan was given on the morning of the tenth day.

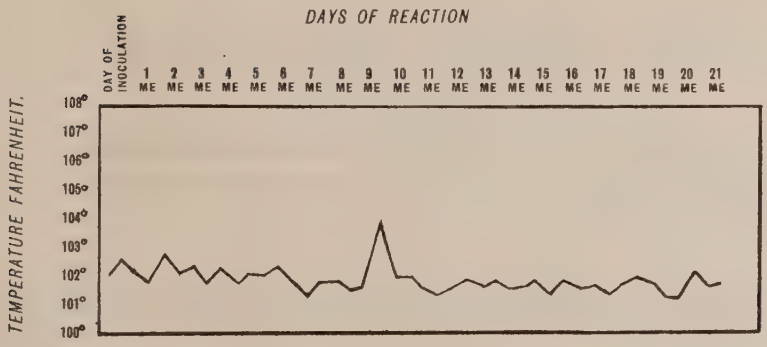
Printed by Survey Dept., Ceylon Mar-52

TEMPERATURE RECORD (CONTD)

PREMUNITION REACTION

IMPORTED JERSEY COW HEAVY IN CALF

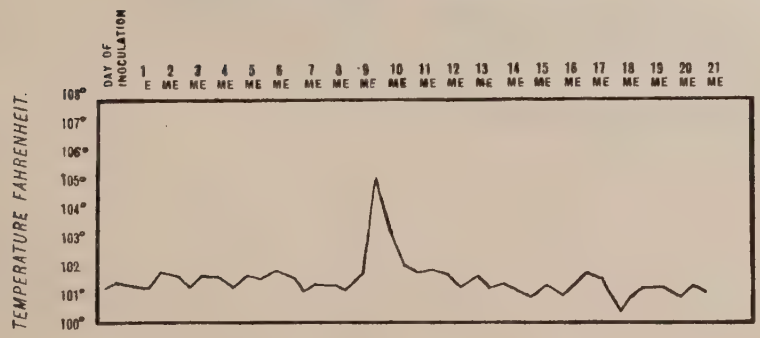
DOSE: 3 c.c. REFRIGERATED BLOOD FOR 4 HOURS



NOTE:- Reaction mild. Temperature came down to normal without treatment.

IMPORTED JERSEY COW HEAVY IN CALF

DOSE: 3 c.c. REFRIGERATED BLOOD FOR 4 HOURS



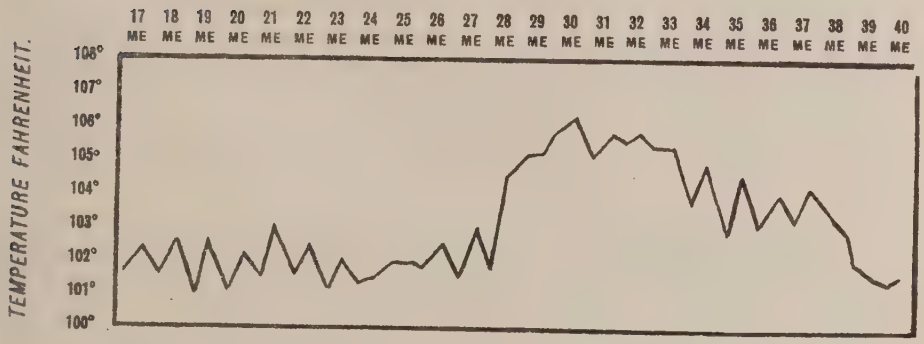
NOTE:- Reaction was controlled with Babesan on the ninth day to prevent such undesireable results as abortion.

Printed by Survey Dept. Ceylon. Mar.-52

TEMPERATURE RECORD (CONTD)

NATURAL INFECTION

IMPORTED JERSEY HEIFER REACTION TO NATURAL INFECTION.
TEMPERATURE COMMENCED TO RISE ABOUT 17th DAY AFTER EXPOSURE.



NOTE:- The animal had to be treated with repeated doses of Babesan and penicillin.
This is rather a severe reaction. In mild cases response to Babesan can be seen within 24 to 48 hours.

Printed By Survey Dept. Ceylon. March 1952.

Variation of Performance in Dairy Cattle*

BY

P. MAHADEVAN

IT is widely known that the variation of performance in dairy cattle is caused partly by environmental factors and partly by individual differences in genetic potentialities for production. It is equally well recognized that only a selection based on genetically caused differences between individuals in a population, will be of any lasting value through an improvement in the heritable qualities of the following generation. Just how big a part is played by each of these two causes of variation and the practical importance of such knowledge are the problems that we wish to discuss in the present paper. These questions can only be answered with certain reservations depending on whether we are dealing with variation within one herd or between different herds or between districts.

We, in Ceylon, know least about the variation between districts. No evidence has hitherto been collected to determine with any degree of accuracy whether the Sinhala cows in the wet zone, for example, yield more milk than their counterparts in the dry zone. Further, even if such differences exist, no evidence is available to determine whether they are due to the genetic superiority of the Sinhala cattle in the wet zone or whether they are attributable to differences in environment. In England and Wales, however, where the milk-recording and herd-book movements have gained wide acceptance among private dairy farmers, it has been possible to gather sufficient data which shows that within breeds, there is, in general, an east-west trend consisting mainly of high milk yields and poor fat percentages in the lowlands of the east, and low milk yields and high fat percentages in the hilly regions of the west, particularly in Devon and Cornwall and Cumberland and Wales. Now, it would appear possible that these differences may be due either to genetic differentiation of local types within breeds, or to variation in feeding and management between the east and west. Two investigators, Robertson and Asker (1949), working in collaboration, traced the ancestry of the cows in the different regions, and found that there was much too much exchange between areas for any genetic differences to build up, and in particular that certain areas become common sources of breeding stock for the whole country. Their results show, in fact, that no county gets less than 7 per. cent of its Shorthorn bulls from Cumberland, while Scotland and Essex are great sources of Friesian bulls. The general conclusion to be drawn from this study

* A paper read at the Seventh Annual Sessions of the Ceylon Association of Science in Dec. 1951.

is that the variation in milk yield and butterfat percentage between districts in England and Wales is largely environmental.

While there is no evidence regarding variation between districts in Ceylon, a little information is however coming along as regards variation between herds. On *a priori* grounds alone there are several reasons for expecting differences in yield between herds through differences in management. But the little data that has just been gathered is not sufficient to measure conclusively just how much of the differences are genetic and how much environmental. The best method by which the causes of variation in yield between herds could be partitioned, is by using the same bulls in herds with widely different average yields. If the herd averages differ due to genetic reasons, a bull from a high-yielding herd could raise the average level of production of a low-yielding herd. On the other hand, if the differences in herd averages are environmental in origin the same bull would have no effect on the average level of production of the low-yielding herd. In fact, the preliminary results obtained from artificial insemination work in the U. K., indicate that the latter is much nearer what happens than the former, and that on the average, what distinguishes a high-yielding herd from a low-yielding one of the same breed, is probably, for the most part, the skill of the farmer. The few figures that are gradually accumulating in Ceylon show much the same trend, but more convincing evidence will be available when the results of the artificial insemination scheme that has recently been started in connection with progeny testing, become available.

One practical consequence of the environmental variation in yield between herds comes in when a breeder, sooner or later, in order to avoid inbreeding, must go outside his own herd to buy a bull. What should a breeder look for in purchasing a bull? In the first place, he must determine whether the herd from which he hopes to purchase the bull, is genetically above the mean level of his own herd. This is important, because even though the other herd may be a high-yielding one it does not necessarily follow that it is genetically superior to his own herd. The superiority may be almost entirely due, as is generally the case, to skilled management. If this be so, purchasing a bull from a high-yielding herd purely on the grounds that the herd average is high, is one of the greatest mistakes that a breeder can make. After all, a bull has no power of transmitting skilled methods from one herd to another. In other words, when you buy a bull, do not hope to buy his herd average with him.

The second point that a breeder should look for when purchasing a bull is whether the bull is genetically above the mean of the herd in which he was bred. No bull should be purchased unless his dam's yield is considerably higher than the mean of the herd to which he belongs. It can be shown that if we consider a herd whose average yield is 900 gallons, the dams of prospective bulls that may be purchased from that herd, should average at least 1260 gallons.

Finally, let us consider the question of variation within herds. A fair amount of evidence has now been gathered together by analytical work on dairy cattle data both in this country and abroad, which shows that even

after allowance has been made for known environmental factors such as age, month of calving and length of calving interval, there is still a large amount of variation within herds due to intangible differences in environment. Actual tests obtained by comparing the production of a large number of daughters and dams on an intra-sire basis, and by comparing the production of half-sisters or other close relatives, have shown that only a small part of the variation in milk yield within herds is due to genetic causes. They account for about one quarter of all the differences in milk yield between single records found in any one herd. This fraction, one quarter, represents the proportion of the total variability in corrected performance that is due to genetic causes, and is called the " heritability " of the character in question.

If all the differences in yield in a herd were due to genetic causes, i.e., if the heritability were unity instead of one quarter, one would expect the difference in yield between any two animals to be a direct reflection of the difference between their parents. In other words, if two cows differing in milk yield by 100 gallons were mated to the same bull, one would expect the difference between their daughters to be 50 gallons. In actual fact, however, the difference has been found to be closer to $12\frac{1}{2}$ gallons than to 50 gallons. This accounts for the host of disappointments encountered by many dairy farmers who fail to recognize that these are an automatic consequence of the non-inheritance of environmentally caused variations.

From the point of view of applied breeding therefore, it may be stated that genetic differences between cows are overlaid to a very large extent by environmental ones. In consequence, it is of the utmost importance to remember that the maximum improvement attainable by any breeding method is dependent on the fullest use being made of the genetic fraction causing variation in milk yield.

Let us consider in this connection the simplest and most direct way of breeding dairy cattle, which is mass selection, and which involves the choosing of breeding stock purely on the basis of their own phenotype and mating the chosen animals at random. It is possible to show from theoretical considerations, that, given optimum conditions of selection, the expected rate of genetic improvement in milk yield is only of the order of 1 per cent. of the average yield per year. This means that among the Sinhala cattle in Ceylon, for example, the maximum genetic improvement by selection over a period of 20 years can only be about 18 to 20 gallons. This is due to the fact that the rate of genetic improvement is limited by such considerations as the intensity of selection possible and the heritability of the character being investigated. If a population is to be maintained at a constant or expanding size, there would be a natural limitation to the selection intensity possible depending on the reproductive and mortality rates prevailing. The rate of improvement possible would also be low if the heritability of the trait under consideration is low.

In one herd of Sinhala cattle that we have examined in great detail, the actual genetic improvement achieved over a period of 13 years is under 8 gallons—a change which is difficult to detect under the existing variations from year to year. Similar results have been obtained for another breed

of tropical cattle by Robertson (1951) who has analysed the milk yield data from a Fulani herd at Shika, Nigeria. On the other hand, the Pusa herd in India has often been cited by numerous observers, as an example of rapid improvement in milk yield that could be attained by selection. If a little more attention were paid by these observers to study the records and subject them to a genetical analysis, they would have seen that a very considerable part of the overall increase in yield was due to changes in management, and not to selection. In fact, the Pusa herd reached its high level of production under 4 times milking and with a ration of high quality concentrates of 1 lb. to 3 lb. of milk. Although from a practical point of view what matters is that the improvement has been achieved, yet from the point of view of general breeding policy what we require to know is how much of the improvement is genetical and how much environmental in origin. The Pusa herd data have not yet been analysed in this manner.

From the theoretical estimations made by Rendal and Robertson (1950) under optimum conditions of selection, and from the actual figures arrived at by Mahadevan (1951) and Robertson (1951), it is evident that the breeding of dairy cattle by mass selection is a very slow business, and that even for the smallest genetic increases to be attained, the most stringent selection should be applied. There has, however, not been enough time here to deal with the many related topics such as pedigree evaluation, progeny testing, and so on. But we may conclude from our present knowledge of the variation of performance in dairy cattle that there are two alternative long-term policies in livestock improvement work under tropical conditions. One consists of improving the indigenous stock by the usual methods of selection and progeny testing, while the other involves the production of a new breed by crossing the local stock with a foreign breed of superior performance and inter-breeding the progeny. As regards the first method, we now know how slow progress will be. For a more rapid rate of advancement therefore, one is compelled to resort to the second method, though the results are likely to be uncertain because the later crosses, although capable of a reasonably higher level of production than the local animals, may not have all the stamina and adaptability of the latter. However, if the foreign breed has an average production under local conditions which is very much higher than that of the indigenous cattle, that initial superiority of the foreign breed can only be equalled by the indigenous stock after many, many years of selection within the latter. On the basis of the results reported above, it will be readily seen that if we adopt selection within the local stock as the only means of livestock improvement, it would take us over 200 years to raise the average level of production of the Sinhala cattle in Ceylon to anything comparable to the yields given by Jersey cattle under local conditions. It would seem therefore that the two methods of improvement should be given about equal chance in any sensible programme of livestock improvement under tropical conditions. The crossing method would give a considerable increase at the start which could be consolidated by the usual selection methods, while the selection of local stock will be a standby if the crosses are found to be really unsuitable to the climate.

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Plant Import Legislation in Ceylon

BY

M. P. D. PINTO

THE subject of insect pests has assumed such great importance that there is hardly any civilized country which has failed to take very serious notice of the " insect menace " or the " dominance of insects " in the world today. Insects inflict colossal losses annually. As pests of cultivated plants they are a perpetual menace and are a very important contributory factor for the shortage of food which is one of the gravest problems now facing Ceylon and the rest of the world.

Similarly, tremendous damage to cultivated crops is caused by plant diseases such as the notorious coffee leaf disease which ruined a flourishing coffee industry in the Island causing a loss of £17,000,000. Loss is also caused by weeds which not only reduce crop yields but also seriously interfere with agricultural or irrigational operations. They also harbour pests and diseases.

In the fight against pests and diseases of cultivated plants and of weeds it has long been recognized that the assistance of the law must be invoked and there are probably very few countries, if any, today that have not adopted some form of legislation to that end. In Ceylon legislation against pests and diseases of cultivated plants was first introduced in 1901. Since then various amendments to that legislative enactment have taken place.

At present the regulations regarding the control of pests have been issued almost entirely under the Plant Protection Ordinance, No. 10 of 1924 which was enacted " to make better provision against the introduction into Ceylon and against the spread therein of weeds, and pests, and diseases injurious to, or destructive of, plants and for the sanitation of plants in Ceylon."

This Ordinance thus makes provision not only for the control of serious pests already occurring in the Island but also for the prevention of introduction into the country of insect pests, diseases, and weeds from outside. To prevent the importation of foreign pests under this Ordinance regulations have been framed from time to time prohibiting or restricting the import of plant matter and insects into the Island.

The need for such import prohibitions and restrictions is obvious. It may, perhaps, be of interest to mention that some, if not most, of the most destructive pests, diseases and weeds in the country are those that have been inadvertently imported from outside. Blister blight of tea, which has raised grave problems in the tea industry, is a recent example.

Each of these foreign pests is responsible annually for enormous losses ; and will continue to be so indefinitely. Once established they, like the poor, will always remain with us. It is simple enough to imagine what the country would save each year, and how much more food and raw material would be available for our use, if, for example, the bunchy-top disease of plantains, or the coffee berry-borer, or the Kalutara snail, or the blister blight of tea or the weed water hyacinth, or other noxious pests could have been prevented from gaining entry into the Island.

Beside those occurring here, there are numerous other important insect pests and fungus, bacterial or virus diseases in other countries which gaze hungrily at our plantations, fields and orchards. If they happen to be introduced and become established agriculture would be gravely affected ; each would cause similar or more serious loss as those which have unfortunately gained admittance into the country. One such example of a pest is the Mediterranean fruit-fly whose introduction into the Island it has been possible to avert by the narrowest margin.

The Mediterranean fruit-fly is, perhaps, the most destructive known pest of fruits and some vegetables, and is a serious menace in almost all the countries where it occurs. If by some misfortune it gains admittance and establishes itself in the Island its eradication would be economically impracticable as is the case with the other unwelcome introductions in the past. It would represent a major problem in insect control, parallel to the blister blight of tea, and remain to inflict enormous losses annually not only to growers of fruits but also to peasant cultivators since such vegetables as gourds, cucumber and brinjal are also liable to serious attacks.

This pest created a sensation in the United States when it was discovered for the first time in 1929 in Florida. Realizing that the best protection the State could have when invaded by the pest was its extermination a vigorous campaign was instituted immediately on the discovery of the fly and before it could spread when eradication would become almost impossible. Although some were sceptical of its successful eradication even at that initial stage, the campaign proved most effective.

Apart from the inconvenience due to the quarantine and the loss fruit-growers and others were subjected to, the Federal Government alone expended in less than two years £1,256,000 in this venture. This money was well invested and had been the means of saving a great deal annually not only for the fruit-growers but also for the nation.

The growing importance of insect pest and plant disease problems has constantly increased the need for efficient plant pest inspection and quarantine service. The realization that hundreds of noxious foreign pests and diseases have not been introduced and established provides convincing evidence that all feasible efforts should be made to maintain an effective foreign plant quarantine system. It is hardly necessary to point out that the amount saved in preventing the establishment of one pest or disease having the potentialities of those imported pests mentioned above would be far in excess of that spent for an all-time efficient foreign plant quarantine organization.

The maintenance of the plant quarantine work of the Island entails the careful and thorough examination of imported plant material and the large-scale fumigation and other treatment, where necessary, and carrying out of other measures for the purpose of preventing introduction of dangerous pests. It also includes the issue of health certificates, after examination and fumigation, if necessary, of certain plant matter prior to export.

Practically all the civilized countries of the world are realizing more and more the utmost importance of preventing the addition of foreign pests to those already occurring in a country. The possibility of introducing inadvertently undesirable pests into a country has become much greater than ever before. With the recent expansion of commercial oceanic and air traffic and the very rapid transport which permits live insects to be readily carried to various countries from distant and hitherto considered remote places the problem of preventing the dissemination of plant pests and diseases has assumed international importance.

SUMMARY OF PLANT IMPORT REGULATIONS

For the purpose of preventing the introduction into Ceylon of weeds, and of pests and diseases of cultivated plants, various regulations have been framed from time to time under the Plant Protection Ordinance, No. 10 of 1924, regarding the import of plants and insects into the Island. These regulations may be added to, amended or revoked as and when necessary by notification in the *Ceylon Government Gazette.*

The legislation summarized below provides for the examination of all imported living plants or parts of plants, for their fumigation, or disinfection when necessary and if expedient their destruction. It also provides for the quarantine of imported plants should this be considered necessary. Provision is made for prohibition of importation of certain plant material while some plants are permitted entry only subject to special conditions. The following is a summary of the regulations at present in force.

Prohibitions.—The regulations completely prohibit the importation into the Island of any seed or plant from the American Tropics or any country where the South American leaf disease of *Hevea* rubber occurs. They also prohibit the importation of coconut plants ; sweet potato tubers from Africa ; any seed or plant of any species of *Helianthus* grown in the Western Hemisphere ; any sugarcane sett other than by the Director of Agriculture ; any aquatic plant ; and any of the plants known as (i) Rice grass (*Spartina townsendii*), (ii) Black berry (*Rubus fruticosus*), or (iii) Cape tulips (*Homeria collina* and *H miniata*). Importation of tomato seed is also prohibited except from India and except under a permit in writing from the Director of Agriculture.

Import of plants packed with soil is prohibited. It is unlawful for any person other than the Director of Agriculture to import into or land in Ceylon any plant packed with soil or compost other than mulch which can be completely removed from the plant and subjected to sterilization ; and so it is to land at any port any refuse or sweepings containing vegetable matter from any ship or aircraft which has arrived from any place outside Ceylon.

The need for the prohibition of importation of coconut plants is mainly to prevent entry into Ceylon along with these plants of foreign insects such as beetles, caterpillars and scale insects from other countries where several of them are known to cause extensive damage to coconut palms. Similarly to safeguard the country from the introduction of virulent virus diseases not known to occur here the importation of sweet potato tubers from Africa and any seed or plant of *Helianthus*, including sunflower, from the Western Hemisphere is prohibited. Importation, other than by the Director of Agriculture, of sugarcane setts is not permitted to prevent the accidental importation of mosaic disease. Such setts can also be an excellent channel for the carriage of sugarcane-borers and leaf-hoppers unknown in this country.

A very serious bacterial disease of tomato, the Grand Rapids disease also known as Bacterial Canker of tomato, has been recorded in various countries and to prevent the introduction of this seed-borne disease importation of tomato seed into Ceylon has been prohibited. Since this disease has so far not been recorded in India obtaining of seed from this country is permitted subject, however, to such conditions as the Director of Agriculture may specify.

The two serious water weeds in Ceylon—the Water Hyacinth and the Water Fern—are both plants introduced from outside. To prevent the further introduction of such weeds which can be a menace to irrigation systems importation of aquatic plants is prohibited. Similarly the importation of Rice grass, Black berry and Cape tulips is prohibited to prevent introduction of these foreign plants which have become very serious weed pests in countries where they have been introduced for ornamental and other purposes.

Restrictions.—The following imports are conditionally prohibited. Importation into Ceylon is permitted only under a permit issued by the Director of Agriculture or by an authorized officer of the Department of Agriculture who shall specify the terms and conditions under which such licence is issued.

A permit in writing from the Director of Agriculture should previously be obtained to import any plant or part of a plant by aircraft; a living specimen of any insect or invertebrate animal; any seed or plant of any species of *Hevea* rubber; any seed (other than cured seed) of cacao; any seed or unginned cotton or raw ginned cotton of any species of *Gossypium* grown in the Western Hemisphere; any living part of the cassava or manioc plant; and any citrus plant of any species. A permit to import citrus plants will be issued only if the Director of Agriculture is satisfied that the country from which the plants are to be imported is free from any virus disease of citrus plants.

A licence from the Director of Agriculture is also required to import into or land in Ceylon fresh fruits. It is unlawful for a person to land any fruit unless he has satisfied the Principal Collector of Customs that such fruit was grown in and consigned from the country specified in the licence. The Director of Agriculture will not issue a licence to import fruits from any country in which the Mediterranean fruit-fly or any other pest of fruits which has not become established in Ceylon is known or suspected to exist. A

licence may, however, be issued if the Director of Agriculture is satisfied that either before export from such country or during transit to Ceylon that the fruit is so treated as to ensure that such pest, in all its stages, is effectively destroyed.

Although the importation of rubber seeds and plants from countries where the serious South American leaf disease of *Hevea* exists is completely prohibited importation from other countries is permitted under conditions imposed by the Director of Agriculture. The need for such restrictions is to prevent the introduction of other rubber diseases not occurring in Ceylon. Similarly it has been considered desirable to restrict the import of plants and seeds of cacao to prevent the introduction of diseases of cacao unknown here particularly of the Witches' Broom, and of the Swollen Shoot virus disease which has caused tremendous loss in West Africa.

The fact that citrus diseases, which in some cases are known to be of the nature of viruses, have been recorded in certain countries has been the reason to introduce legislation to prevent diseases of this complex being introduced with citrus plants into Ceylon. And the importation of cassava has been restricted because this plant is subject to a serious virus disease unknown in Ceylon. The object in prohibiting the importation of cotton seed or unginned cotton grown in the Western Hemisphere except under a licence from the Director of Agriculture is to eliminate the risk of introduction of such destructive pests as the notorious Mexican cotton boll weevil now present in most of the cotton-growing countries of the West.

Ports of Entry.—It should be mentioned also that under the existing regulations importation of plants is permitted only through the ports of Colombo and Talaimannar or the airport of Colombo (Ratmalana) or the Royal Air Force Station, Negombo.

Inspection, Fumigation, or Disinfection.—All living imported plants or parts of plants except potatoes, onions, turmeric, culinary seed, edible vegetables, and the seed of such vegetables other than of tomato, and the seed of any ornamental plant are subjected to examination before passing out of the Customs. They together with the packing cases, pots or coverings in which such plants may be packed are conveyed by Customs or Postal authorities to the Inspector-in-charge of the Colombo Fumigatorium who shall examine them and, where necessary, ascertain that the terms and conditions specified in the licences issued by the Director of Agriculture have been complied with.

Every plant which on inspection is found or suspected to be infected with any pest or disease will be subjected to fumigation and/or disinfection at the risk and expense of the consignee or his agent. The consignee or his agent should be present during the process of unpacking the articles for inspection, fumigation or disinfection and of repacking thereafter. He also should provide the labour necessary for handling the articles.

Quarantine and Destruction.—If after inspection it is considered necessary, the Director of Agriculture is empowered to order that any plant so inspected be grown for a period of quarantine in special nurseries provided

or approved by him. These plants will be grown at the risk of the consignee and are not to be removed without a written permit from the Director of Agriculture.

Any imported plant or part of plant which in the judgment of the Inspector-in-charge of the Colombo Fumigatorium cannot be cleaned by fumigation or other treatment and which is not necessary for further observation will be destroyed together with the packings or covering in which it may be packed. Such destruction will be carried out at the expense of the consignee.

The above orders and regulations no doubt cause a certain amount of inconvenience, or even loss, to the general public. In view of what has been stated earlier they will, however, understand and appreciate the imperative need for the introduction of such legislation. The establishment of a number of dangerous pests, diseases and weeds of foreign origin already in the country, each causing very serious loss annually, should convince that increased emphasis must be placed not only on performing the plant quarantine function in a manner that will cause the least inconvenience or loss to the public but also in employing at the same time every safeguard reasonably necessary to prevent the introduction of undesirable foreign pests which menace our agriculture.

DEPARTMENTAL NOTES

DAIRYING

THE Government Dairy, Undugoda, which was opened towards the end of 1948 has shown during the last year a considerable improvement in milk production as a result of certain changes in the methods of management adopted by the Farm Manager, Mr. N. Sanmugam, who assumed duties early in 1951.

The composition of the milk herd between October, 1950 and October, 1951, is shown in Table I :—

TABLE I

Breeds	*October, 1950* *No.*	*October, 1951* *No.*
European	14	10
European X Scindi cows	10	9
Scindi	41	55
	65	74

The proportion of cows in milk and the total milk yield for the months under review are given in Tables II and III :—

TABLE II

	October, 1950	*October, 1951*
Total No. of cows	65	74
No. in milk	35	56
Percentage in milk	54	75

TABLE III

	October, 1950 *lb.*	*October, 1951* *lb.*
Total	11,922	20,065
Average per day	384	647

The average milk yields for the 3 groups of cows is given in Table IV :—

TABLE IV

Breeds	*October, 1950*		*October, 1951*	
	Average per milk cow *lb.*	*Herd Average* *lb.*	*Average per milk cow* *lb.*	*Herd Average* *lb.*
European	13·9	7·3	13·3	11·9
European X Scindi cows	12·7	10·1	20·3	18·2
Scindi	10·0	4·4	10·1	7·1
Whole herd	11·1	5·7	12·1	9·1

The increase in milk yield are attributed by the Farm Manager to the following methods adopted by him :—

(i) Cooling of the milking shed by covering the asbestos roof with cadjans.

(ii) Increase in the rotations. Scindi cows in milk are given 2 lb., European and cross bred cows 3–5 lb. each for maintenance. In addition Scindi cows receive 45 lb. of grass and European and cross bred 60 lb. Cows in calf are given 2 lb. more of concentrates and a month before calfing 1 to 2 lb. extra of wheat bran. As a result the lactation periods of the cows in milk are extended and about 50 per cent. have to be forced dried when they have been in milk for the full period (305 days).

(iii) The system of weaning by muzzling the calves. During milking, the muzzled calves are allowed to remain beside their mothers. The calf has no access to the udder but the mother satisfies her instinct to suckle her calf by licking it. The cows are milked dry and a portion of the milk that is drawn is fed to the calves from buckets. Under this system the cow drops its milk as soon as the udder is cleaned, but in the case of a cow that suckles its calf the milk is not dropped until the calf sucks the udder. If a calf falls ill it does not suck the udder and the milk yield falls and should it die the milk soon stops.

It is generally experienced that Scindi and other Indian as well as the local sinhala breeds are difficult to wean unless steps are taken with the first calf. Any attempt to wean the calf later will result in an abrupt stoppage of milk from the mother. With muzzling, however, weaning can be practised with the birth of any calf irrespective of whether it is the first or a later calf.

Meetings and Conferences

PROCEEDINGS OF THE ELEVENTH MEETING OF THE CENTRAL BOARD OF AGRICULTURE, HELD IN THE BOARD ROOM AT THE ROYAL BOTANIC GARDENS, PERADENIYA, ON OCTOBER 8, 1951, AT 2 P.M.

Dr. A. W. R. Joachim, Director of Agriculture presided and the following were present :—

Mr. C. N. E. J. de Mel (Deputy Director of Agriculture); Mr. T. M. Z. Mahamooth (Deputy Director, Animal Husbandry) ; Mr. Thomas Amarasuriya (Chairman, Low Country Products Association) ; Mr. A. Hensman ; Mr. Chas A. M. de Silva (Vice President, C. B. A.) ; Mr. U. B. Dedigama, R. M. ; Mr. S. B. Yatawara (Deputy Registrar of Co-op. Societies) ; Mr. S. L. Bandara Dharmakirti, J.P. ; Dissawa A. E. Madawala ; Mr. D. B. Ellepola (Director, Rural Development) ; Dr. W. R. C. Paul (Assistant Director of Agriculture, Technical) ; Mr. Marcus S. Rockwood ; Mr. W. A. Guthrie (Director of Irrigation) ; Mr. A. M. Clement Dias ; Mr. R. T. Chelliah ; Mr. A. Perumynar ; Mr. K. Sittambalam (representing the Marketing Commissioner) ; Mr. E. Abeyaratne (Agricultural Research Officer, Maha Illuppalama) ; Mr. S. Sivapalan, M.P. ; Dissawa Sam Elapata ; Mr. A. L. Johnpulle (Divisional Agricultural Officer, Uva) ; Dr. M. F. Chandraratne (Botanist and Senior Agricultural Research Officer) ; Mr. W. M. Cumaraswamy ; Rev. Fr. L. W. Wickremasinghe ; Sir James P. Obeysekera ; Major E. C. de Fonseka, M.B.E., E.D. ; Gate Mudaliyar N. Wickremaratne ; Mr. W. P. A. Wickremasinghe, M.P. ; and Mr. R. L. Arnolda, C.C.S. Secretary, Central Board of Agriculture.

Mr. J. P. Blackmore was present as a visitor.

Letters and telegrams regretting inability to attend the meeting were received from the following :—Director, Tea Research Institute of Ceylon ; Mr. E. Muttukumaru ; Mudaliyar Abulcassim Maraikar ; Mr. R. H. Spencer Schrader ; Hon. Mr. H. W. Amarasuriya, Minister of Commerce & Trade ; Mr. F. C. Cooke, Director, Coconut Research Institute of Ceylon ; Sir Wilfred de Soysa ; Senator C. Wijesinghe ; and Director, Rubber Research Scheme.

I—CONFIRMATION OF THE MINUTES OF THE LAST MEETING

The minutes of the 10th meeting of the Central Board of Agriculture were unanimously confirmed as correct.

II—TABLE LETTER DATED JULY 19, 1951, RECEIVED FROM MR. D. RHIND

A vote of appreciation of Mr. Rhind's services to the Island as Director of Agriculture was unanimously adopted by the Central Board of Agriculture and was conveyed to him. Mr. Rhind's reply to this communication was a letter dated July 19, 1951, which was read by the Chairman at the Board Meeting.

III—TABLE LETTER RECEIVED FROM THE MINISTRY OF AGRICULTURE AND LANDS IN REGARD TO AN EARLIER RESOLUTION OF THE BOARD RECOMMENDING THE FORMATION OF A MILK BOARD

The Executive Committee of the Central Board had recommended and forwarded to the Ministry a resolution on the formation of a Milk Board and the reply received was to the effect that the Ministry of Health was taking steps to implement the recommendations of the Milk Committee. This reply was read by the Chairman for the information of all members.

The Chairman commenting on this resolution said that there was already a draft bill to be presented to Parliament regarding a Milk Board. He added that it was a matter for satisfaction that a proposal which had found support from the Central Board had met with Government approval. He had no doubt that the Milk Board would become a reality before long.

III—(*a*) TABLE REPORT OF THE SUB-COMMITTEE APPOINTED BY THE BOARD TO GO INTO THE QUESTION OF CROP AND CATTLE INSURANCE

Mr. C. N. E. J. de Mel, Deputy Director of Agriculture who was appointed Chairman of the Sub-Committee formally presented the report before the House. Copies of the report were circulated to all members. He said he would like to make a very few brief remarks on the report as desired by the Chairman. The resolutions passed by the Board were two, one in regard to Crop Insurance and the other in regard to Cattle Insurance, and the Board had desired the sub-Committee to draw up a comprehensive scheme. He added that the report would indicate that the sub-Committee had felt it was not in a position either to draw up a scheme of Crop Insurance or Cattle Insurance. The reason was that the subject was discussed fairly thoroughly by the sub-Committee and found to be bristling with difficulties. Crop and Cattle Insurance Schemes have not yet been adopted successfully in any country except America because a number of difficulties had to be surmounted. But even there the latest reports stated that the subject needed considerable revision in the light of experience. Therefore to submit to the Board a comprehensive scheme of Crop and Cattle Insurance was beyond the capabilities of the sub-Committee, and the sub-Committee favoured that some of their suggestions be placed before the Board which would give an indication of the type of difficulties they were confronted with. At the instance of the Director of Rural Development, who suggested that the report should embody important arguments on various problems, the sub-Committee agreed that this should be done to enable this Board to understand differences in points of view. In America the cattle population is not threatened by disease because it is well under the control of a large number of Veterinary Surgeons. In fact they have no Insurance for cattle except for very valuable animals which are insured with Insurance Companies. Details of Cattle Insurance in Denmark were given by Mr. Anker and are included in the appendix to the report. The appendix had been drawn up particularly to give some authoritative information on the subject obtained from other countries to which reference had been made. The sub-Committee felt that the best line of procedure for cattle insurance would be to have Co-operative Societies, the members of which would themselves take an interest and sufficient care of their animals. It was also suggested that the present Co-operative Societies could not undertake Insurance and that separate Co-operative Societies would have to be formed with Government help. If Government help was forthcoming, perhaps the Co-operative Department would be able to undertake a number of special Co-operative Societies for Cattle Insurance. In reference to the appendix to the report, Mr. de Mel read the following sentence—" The promoters of cattle insurance in Burma have pointed out the intimate relationship between the work of a Co-operative Credit Society and of a Cattle Insurance Society, especially in relation to the protection of cattle from disease. "

The reports dealing with Cattle and Crop Insurance in India reached the sub-Committee only after their last meeting. The sub-Committee, however, decided that there should not be any further meetings of the Committee and therefore some of that information received had to be incorporated in the Appendix.

In regard to Crop Insurance he said that the question of paddy was an extraordinarily intricate one. Some countries like America had launched Crop Insurance Schemes long ago in 1938 ; but in 1941 they had found the scheme to be working at a large deficit and finally it had to be suspended. He emphasized that the subject of Crop Insurance was full of great difficulties. Crop Insurance in America started on a small scale confined to a few countries and confined to one crop. It had been extended to a number of other crops and the number of counties were also increased. The scheme is an entirely voluntary one, assisted by the Central Government of the United States with a subsidy for expenses of administration. Except for this subsidy, the scheme would be self-supporting. The premiums would naturally have to be high. Everything had to be decided by proper statistics of crops and their yields. They are constantly changing the scheme to make it more perfect. The scheme that India had formulated is referred to in the appendix to the report of the sub-Committee. He quoted the following :—" There is said to be a scheme of compulsory crop insurance operating since 1943 in Dewas Junior State administered by a corporation with a managing committee. "

In India itself the subject is yet being formulated. The scheme under consideration is on the lines of the U. S. A. Scheme with modifications.

" All proposals for fundamental reform in the agricultural economy of India in recent years have stressed the need of schemes of agricultural insurance as an integral part of any programme of agricultural reforms. At present India provides the cultivator a type of insurance in the system of remissions and suspensions of land revenue when crops have been adversely affected. It is recognized that crop insurance in India will have to be started on a pilot scheme in which experimentation will have to show the way for overcoming the very numerous difficulties that would arise in formulating such a scheme under Indian conditions. The wide disparity between agricultural conditions in India and in the U.S.A. have to be taken into account. The ignorance and poverty of the average cultivator in India, his conservatism, improvidence, short-sightedness and fatalism are factors that must be reckoned. The small size of the cultivated holding and its fragmentation in India and the wide variety of agricultural practices must also be considered. In fact it has been argued that in a subsistence economy such as the one prevalent in India, a scheme of crop insurance is not feasible or at any rate that it is premature. This may be disputed, since crop insurance is only a more efficient and economical way of providing against calamities whose impact most cultivators are meeting today, in one way or another. "

In the course of discussion at the sub-Committee some vital points had arisen, as for example, whether crop insurance should be voluntary or compulsory. There were great differences of opinion on the question and the Committee had desired that arguments for and against compulsory insurance should be incorporated in the report and placed before the Board.

Mr. de Mel continuing said that another point he would like to mention was the question of relief schemes in Ceylon when the paddy crops failed. He had obtained some statistics from Government Agents regarding relief work in this country. Those relief schemes had helped the people when there were failures of crops and also various operations carried out under relief work had benefited the country, especially in the case of irrigation works and other works. In India there is a tax levied on crops which is partly or wholly waived in the event of a failure of crops. The Committee was of opinion that the money Government would have to spend on relief schemes could be utilized to subsidize schemes of Insurance. The idea was that Crop Insurance or Cattle Insurance would have to be heavily subsidized by Government.

The Chairman said that the House had just heard the Chairman of the sub-Committee on their report. He thought the best procedure was to leave it now open for discussion by the Board so that divergent views, if any, might be expressed.

Gate Mudaliyar N. Wickremaratne said that he signed the report that day subject to whatever he had to say at the meeting in regard to it. He said that on March 19, a meeting of the Central Board was held at which it was decided to appoint a sub-Committee to go into that matter. A meeting of the sub-Committee was held on May 7, and the last meeting was on July 9. From July 9 till September 25, the report of the sub-Committee was not seen by any member of the sub-Committee. He had written two letters requesting that that report be circulated before the meeting. If he had seen that report earlier he would certainly have written to the Chairman and other members of the sub-Committee urging that another meeting should be held before submitting the final report. In his opinion the submission of the sub-Committee was not a report. He said the report contained only some discussions for and against the proposals, and there was no finality reached on the main subject at issue. He said nevertheless they all owed their thanks to the Chairman of the sub-Committee for the interest he had taken to collect relevant literature from all parts of the world and for the interest he had taken in conducting the meetings. He was however unable to agree with the report because there was no conclusion as to what line of action should be followed in regard to Cattle and Crop Insurance.

At the beginning Dr. Mahamooth, Deputy Director of Animal Husbandry gave the Committee certain information regarding cattle insurance available from most parts of the world. The members of the Committee were guided by the advice of experts from abroad and an expert from Denmark was present by invitation at the discussions. He said he was always for expert opinion but he could not agree that expert opinion from abroad would help in that matter as those experts were not aware of local conditions prevailing in this Island. He said he was also against comparing conditions in this Island to that of America. Referring to an article that appeared in the press regarding the Forest Department, he said that there was a recommendation that the Sinharaja Adaviya should be exploited again. He emphasized that the Forest Department had been responsible for the soil erosion of this country. He said that the members would no doubt consider that 10 years ago Ceylon was spending only a few lakhs of rupees on her food whereas today the country had to spend millions on her food. Today the responsibility of providing food for the people had been taken over by the Government. Any sensible man either in this Board or outside would agree that some special measures had to be adopted to supply as much food as possible. It is in that direction that an Insurance Scheme as envisaged here would play an important part. If the people were prepared to give 50 per cent. of their effort, Government would give the other 50 per cent. and the total production in the Island could be improved. Therefore, he said, it was not advisable to depend on reports from America or any other country to decide what was essential for our country. Although India was a large country, he did not think that it spent as much on her food as other countries. Cattle are very essential for agriculture and if any improvement is expected in agricultural production, the cattle should be looked after better. The long stretches of paddy fields from Kadugannawa to Kelaniya are cultivated only once a year. Before we could see how the production of these existing fields could be improved, and before we could see that these fields carried two crops a year instead of one, we go in search of new lands. Most cultivators did not like to take the risk of growing two crops a year. But if they were given sufficient security by the formulation of an Insurance Scheme, all cultivators would gladly grow the crops and thereby the production of food in the Island would increase. As regards the report of the sub-Committee he said that the members of the Committee have had some valuable discussions. But he would, however, urge that the report of the sub-Committee should be submitted to another Committee consisting of the Registrar of Co-operative Societies, the Deputy Director of Animal Husbandry, Senator Justin Kotelawala, the Director of Rural Developmet and one member from the Department

of Agriculture who should be asked to draw up a comprehensive report on the discussions that would ensue. He said that the report already submitted to the Board had no conclusive recommendations and felt that it should be recast. If he had seen the report much earlier he would have induced the other members to present a better report and he would never have signed it, but that report they had just seen for the first time. He said that in his opinion that report could not be sent to the Ministry or anybody else. The Chairman of the Committee had been very busy with his official duties but that was no reason why a report of that nature should be sent to the Ministry. As regards the importance of cattle for agriculture, he would wish to say that 700 head of buffaloes were being slaughtered per day in Colombo. If that was so, he did not know what would happen to paddy cultivation in the Island.

Mr. Thomas Amarasuriya (Chairman, Low Country Products Association) speaking next, said that he was handicapped without a copy of the report, but would like to comment on the remarks of the Chairman. The Chairman of the Committee had said that the subject under discussion was bristling with difficulties. He said he would endorse these views but at the same time he would like to state that Crop and Cattle Insurance was a stupendous undertaking. The Chairman of the Committee had just said that even in India although Cattle Insurance was being carried out, they were still making further inquiries to set things in order. The Chairman had also stated that some new literature on the subject had recently been received. Under those circumstances, in fairness to the Committee, he said he would suggest that while the principle of Crop and Cattle Insurance was accepted, and as they were not in a position to implement those schemes immediately, it was prudent for them instead of rushing to conclusions to make further investigations into the question. Therefore he suggested that the matter be referred back to the Committee for further investigation and urged that the subject be given further consideration.

The Chairman of the Sub-Committee in reply to Gate Mudaliyar Wickremaratne said he was not worried about the criticism he had received because all the other members would be with him in what had been done. The report had been drawn on their instructions. The report would show the particular aspects of the problem that were discussed. Therefore he emphasised that the Report that was submitted before the House was fully complete as far as their discussions had gone.

In regard to the delay in submitting the Report he said that after the resolutions in that connection were passed on March 19, he had to be away in India for sometime. On his return he had to collect literature on the subject for study. In fact at the second meeting of the Sub-Committee the proposer of the Resolution wanted the subject closed. He had been distinctly told by the Sub-Committee that another meeting was not necessary and that he should draft the Report on the discussions. Another reason for the delay was that some of the Reports from India and other places reached him somewhere towards the end of August. Important points from this literature were summarised for the benefit of the Board to help in the discussion and all this took time.

The other point he would like to clear was that the mover of the Resolution was under a misunderstanding when he said that we were led by Experts from abroad who did not know local conditions. Mr. Anker was called in for the purpose of gathering some information as to how insurance was carried on in other countries. It was wrong to presume that he and the members of the Sub-Committee were unaware of the fact that a scheme of insurance for this Island should be suited to local conditions. It was far better to start from where somebody had finished rather than to start right from the beginning.

Mr. S. Sivapalan said that he could not agree that the matter be referred back to the Committee or to another Sub-Committee. The Sub-Committee had already gone into the matter fully. They had even collected necessary literature on the subject and circulated among members for their opinion. The Sub-Committee had however not been able to collect the data necessary for the final conclusions as to how such a Scheme could be formulated. He also thought that the recommendation of the Sub-Committee was that difficulties that would have to be encountered should be pointed out and that they should suggest that an officer experienced in that work should be asked to work out details as to how such a scheme should be implemented. Therefore in his opinion what was necessary was to make that recommendation at once to the Ministry instead of referring it to a committee.

Mr. Marcus S. Rockwood at this stage inquired from the Chairman of the Sub-Committee from where the money would come for subsidising the Insurance Scheme. He added that he was not aware of any instance where Government had paid any money as a relief measure for losses of animals during the Hoof and Mouth and other outbreaks of disease.

The Chairman of the Sub-Committee replied that members would form into Co-operative Societies and they would carrry out the Scheme of Insurance and Government would be the underwriters.

Mr. D. B. Ellepola, Director, Rural Development, said that he would wholeheartedly support the view expressed by Mr. Sivapalan in reference to the Report. The function of the Sub-Committee was to investigate the two resolutions that were passed and to report to the Board. They had done so indicating to the Board the difficulties of the problem and had made recommendations in respect of certain vital questions that arise in regard to both those Schemes. Those recommendations were made quite clear to the Board. There were a great deal of difference of opinion on some of the vital issues. One such problem, he recalled, was whether Crop Insurance should be compulsory or voluntary. There were a great deal of difference of opinion and arguments. His suggestion was that the Report should embody some of the views that were expressed for and against those vital questions that naturally arose in the course of discussion of the resolutions. That had been done in the Report and reference had been made to the arguments for and against, and if the House accepted the recommendations in the Report on the basis of those arguments, he did not think that the Board could do anything better than to report to the Ministry that those resolutions were examined in detail by a Sub-Committee and that the Sub-Committee was of the view stated. It should also be stated that for the furtherance of the Scheme the Board was of opinion that Actuaries should be got down with a view to implementing that Scheme for the betterment of agriculture. In conclusion he repeated he would wholeheartedly support the view of Mr. Sivapalan that if that matter was referred to another Sub-Committee, that Sub-Committee would also be up against the same difficulties.

The Chairman said that there were two proposals before the House,one was that the Report of the Sub-Committee should be referred to another Committee to work out details and the other is that the Board should accept the findings of the Sub-Committee with particular reference to the recommendation in the Report that Actuaries should be appointed by Government to go into details of the Scheme. The Chairman explained that this was undoubtedly a specialist's job and that they as agriculturists could only recommend the adoption of a scheme and its general principles, and leave it to an Expert to formulate the Scheme.

Mr. D. B. Ellepola said that since the Committee had accepted the decision taken on those major issues it was for the Board to say that the two resolutions moved were gone into by a Sub-Committee and that the Board accepted its decision that the matter should be referred to Actuaries to work out the Scheme.

At this stage Mr. Thomas Amarasuriya (Chairman, L. C. P. A.) said that he was not pressing his suggestion but he had made it so that the matter might not be torpedoed at that stage.

At this stage Mr. Sivapalan moved the following resolution :—

" THE REPORT OF THE SUB-COMMITTEE BE ACCEPTED BY THE CENTRAL BOARD OF AGRICULTURE AND RECOMMENDATION BE MADE TO GOVERNMENT THAT AS SUGGESTED IN THE REPORT, ACTUARIES BE APPOINTED TO INVESTIGATE THE IMPLICATIONS OF IMPLEMENTING AND ALSO OF FORMULATING A CATTLE AND CROP INSURANCE SCHEME. "

Mr. D. B. Ellepola seconded the resolution.

This motion was put to the House and was carried unanimously.

In reference to a remark made by Gate Mudaliyar Wickremaratne that the Report of the Sub-Committee had been considerably delayed, the Chairman of the Board stated that there was bound to be a certain amount of delay in matters of that nature as it was not always easy to collect the necessary information required.

IV—RESOLUTION TO BE MOVED BY MR. W. P. A. WICKREMASINGHE :—

Mr. W. P. A. Wickremasinghe formally moved that,—

" THIS BOARD RECOMMENDS TO THE HON. THE MINISTER FOR AGRICULTURE AND LANDS TO INSTITUTE AN INVESTIGATION ON THE POSSIBILITIES OF DIVERTING THE SURPLUS WATER OF THE NILWALAGANGA TO THE DRY ZONE OF THE HAMBANTOTA DISTRICT BEFORE RESUMING THE WORK OF THE NILWALAGANGA FLOOD PROTECTION SCHEME ."

In moving the resolution he said that the resolution was brought up at a meeting sometime back but due to unforeseen circumstances he could not be present. He believed that most of the members would be aware of the fact that a certain sum of money had been set aside by the Government for the flood protection scheme of the Nilwalaganga in the 1951/52 Estimates. Members would also be aware of the fact that the Flood Protection Scheme was stopped for six or seven years owing to lack of funds. Every year up to 1950 a sum of about Rs. 40,000 had to be voted for the maintenance of the Flood Protection Scheme. But the current year's estimates had provided for only Rs. 16,000 for that purpose. He brought up that resolution before the Central Board of Agriculture regarding the damming of the river at a suitable place as that matter had been the subject of agitation by proprietors, cultivators and farmers of the Matara district for the last 40 years. The District Agricultural Committee discussed that matter fully and they were unanimously of opinion that the Minister should be asked to investigate the matter for the purpose of developing and conserving water for the Dry Zone. When the Nilwalaganga rises the surplus water was carried down through a very limited area to the Hambantota District. There were three other streams which join at a place called Siyambalagoda. He explained how people of Morawak Korale and Gangaboda Pattu suffered as a result of the flood protection bunds. Certain tributaries of the river joined the main river about 4 miles away from the Matara town. When bunds were put up in the catchment area restricting the overflow of the tributaries the higher portions in that area got inundated. His proposal was that investigations be made whether it is possible to divert the surplus waters of this river to

Hambantota district. During the South-West monsoon from May to July this river gets flooded whereas at the same time of the year the people of Hambantota suffer from drought without sufficient water even for drinking purposes. In the Matara District there was too much water during that period of the year and the flood protection scheme only served the purpose of reducing the velocity of the flow downstream. He further believed that it was a flood protection scheme only for minor floods and did not serve the purpose during major floods. He said that that was one of the few rivers in this Island which starts in the wet zone and flows through the wet zone at a distance of only 7 or 8 miles from the dry zone. What the people of Matara wanted was not a flood protection scheme but irrigation facilities so that water might be given to other areas for greater production. In 1926 when the Flood Protection Scheme was being launched by a certain Irrigation Engineer called Mr. Hillman whose services the Government utilised for one or two years, Mr. Wickremasinghe had also accompanied the Engineer all along the river up to a distance of 20 miles by motor boat for purposes of investigation. He said he mentioned that fact because the Irrigation Department would be aware of Mr. Hillman's report where a suggestion had been made of the possibility of damming the river at a point somewhere towards Siyambalagoda and storing the water in a deep tank and diverting that water for purposes of irrigation to a place called Urumutta. In the Matara district about 4 or 5 thousand acres are cultivated with the help of small tanks. In the Gangabodapattu alone there were about 16,000 acres of paddy land. In the Weligam Korale there were over 5,000 acres. In the Gravets they had over 5,000 acres. Therefore it was evident that out of an area of about 50,000 acres only about 4,000 acres were irrigated by the existing small tanks. If there was a possibility of constructing a deep reservoir as he had suggested, cultivation for both seasons, yala and maha would be possible. During the current yala season cultivation had not been done owing to difficulties of water. The river runs through huge tracts of paddy land but most of the area within the catchment except within a radius of about 4 miles, is not cultivated. There was one tract of 2,100 acres in Akuressa which had not been cultivated for the last four years in succession. That area was only 4 or 5 miles away from Siyambalagoda. He said he was not aware of the engineering difficulties but he was speaking as a layman, and from a layman's point of view the people had urged for such a scheme during the last 40 years. Therefore his request was only that the Minister be asked to make investigations through the Irrigation Department so that it could be known whether such a scheme was practicable or not.

Rev. Fr. L. W. Wickremasinghe in seconding the resolution endorsed the view of Mr. Wickremasinghe that people towards Hambantota had no water even for drinking. Even people from Matara to Tangalla suffered for want of good drinking water because right along the coast the water was brackish. As suggested by Mr. Wickremasinghe if a deep tank could be constructed for collecting and distributing the water, places like Dondra and the neighbouring villages could be served and that would save the area from floods also. He said it was a very good idea but he did not know whether it was workable because he was not aware of the exact condition of the land. The only obstacle he envisaged was a range of hills between the two streams. Nevertheless if investigations were carried out as to whether the waters of the Nilwalaganga could be brought to Tangalla, it would serve a very useful purpose. He therefore supported Mr. Wickremasinghe and urged that the resolution should go before the Minister.

Mr. W. A. Guthrie, Director of Irrigation, made the following observations on Mr. Wickremasinghe's proposal. He said he had himself investigated that proposal and in looking into certain old papers he had found that in 1927 Mr. Hillman had first reported on the Nilwalaganga basin. That river which carries a large volume of flood water appeared to have been investigated in the past with the object of diverting a part of its waters to the

eastern area which was drier than the Nilwalaganga basin. As evidence of that there were two dams which diverted the run-off from two portions of the upper catchment of the Nilwalaganga into the Urubokke Oya and the Kirama Oya in Giruwapattu. He emphasised that it was impossible to harness the waters of the Nilwalaganga entirely to the Dry Zone. First of all there was no suitable site for a reservoir and secondly a major flood protection scheme would not do any good, because major floods occurred very seldom. That was why a minor flood protection scheme was launched.

The Urubokke Dam maintained by the Irrigation Department transferred the water of 10·0 sq. miles of the catchment of the Urubokka Ganga which is a tributary of the Nilwalaganga into the Urubokke Oya. Under the Urubokke Oya a large area was at present being cultivated.

The Kirama Aru which is also a tributary of the Nilwalaganga had been dammed at Kirama to form the Kirama Tank thus cutting off 5.5 sq. miles of the Nilwalaganga catchment. That water was led through a channel into the Kirama Oya and was utilised for the irrigation of a large area of paddy land.

It would be seen therefore that some 15.5 sq. miles of the Nilwalaganga catchment had already been diverted to the Giruwapattu in Hambantota district. The topography of the country made it impossible to divert any further water to the eastern area by means of an economic scheme.

The Kirama Oya and the Urubokke Oya schemes covered the area up to Ranna. The proposed Walawe Ganga Reservoir scheme would serve the irrigation needs of the area between Ranna and Hambantota.

He added that the suggestion of damming the Nilwalaganga to supply water, by means of a deep reservoir, to West Giruwapattu and the surrounding villages of Matara District would involve in enormous expenditure and the cost would be prohibitive.

In conclusion he said he was expecting certain traces of the area from the Matara Kachcheri and asked Mr. Wickremasinghe to keep in touch with him. He also stated that as for Hambantota District, once the proposed Walawe Scheme was implemented, Hambantota District would be amply served.

Mr. W. P. A. Wickremasinghe at this stage said that an Irrigation Officer attached to the A. G. A., Matara, had taken levels of the area at the request of the A. G. A. He said he was not an expert who knew all about irrigation but he felt that water could easily be taken from Gangaboda Pattu, through Denagamuwa, to Walasmulla and the surrounding villages. He said if there was the possibility of erecting a deep reservoir as suggested by him earlier that would be an enormous advantage to paddy cultivation in the Matara District. He wondered whether the Director of Irrigation was aware of the fact that the flood protection scheme was of little advantage to the people. The flood protection bunds served the purpose of protecting paddy fields during the South-West monsoon, whereas those fields were not cultivated during the maha. The fields that were cultivated during the South-West monsoon were the fields that were adversely affected as a result of the flood protection scheme. About six weeks ago there was a big cry in the area asking for relief from Government. The farmers expected a big crop but before the actual harvest the whole area suffered from floods and about 95 per cent. of the fields were badly damaged. The flood waters took about 7 days to subside. His proposal was that there was a possibility of constructing a dam across the river and having a reservoir somewhere upstream towards Siyambalagoda. If that was only possible a huge

acreage of paddy in the Matara District could be cultivated both seasons, yala and maha, and the paddy lands in the catchment area could be irrigated. He was subject to correction but he was only suggesting the investigating of the practicability of that suggestion. He added that production could be stepped up only by harnessing the river, otherwise they had to depend on the rains. The rains sometimes come too early or too late. During the current season the rains came in too early and in September and October there was no rain. The difficulty of the cultivator was that the seed paddy they had was of a variety which was restricted to a certain period from the time of sowing to harvest, so that with the uncertainties of the rains they would not be able to sow that variety of seed.

Gate Mudaliyar Wickremaratne supported the motion in endorsing the views of Mr. Wickremasinghe and felt that the Board should ask either the Director of Irrigation or any other expert to make further investigations on the matter.

Mr. Marcus S. Rockwood said that he had learnt from an officer who investigated the flood protection scheme that he was only asked to report on the flood protection scheme and not about any other possibilities. Therefore he presumed that there were other possibilities of irrigation apart from the flood protection scheme.

Mr. W. A. Guthrie said that so far he had not been able to get the tracings but his view was that such a scheme was not practicable and would not be feasible.

At this stage Mr. W. P. A. Wickremasinghe mover of the resolution said that he wished to withdraw his resolution in view of what had been said by the Director of Irrigation. He however requested that the Department of Irrigation be requested to investigate in relation to flood protection, a means of providing water from this source for the irrigation of paddy lands in the Matara District. He also pointed out that only less than 1/10th of the total acreage in paddy had irrigation facilities.

Item 5—Resolution to be moved by Gate Mudaliyar N. Wickremaratne :—

> "IN ORDER TO ENCOURAGE PRODUCTION OF MORE FOOD FROM THE EXISTING PADDY FIELDS AND ALSO IN CERTAIN CASES TO PROTECT PADDY FIELDS FROM DISUSE AS PADDY FIELDS BY SILTING, THAT IMMEDIATE STEPS SHOULD BE TAKEN BY GOVERNMENT TO PRESERVE AND RESTORE PITA ELAS AND WANATHAS BORDERING TEA AND RUBBER LANDS IN THE UP-COUNTRY DISTRICTS IN THE ISLAND."

Mr. S. Sivapalan drew the attention of Mudaliyar Wickremaratne to the fact that there was already a large vote in the budget for the protection of paddy fields and the improvements envisaged in the resolution and he was sure that the work could be undertaken from this vote. He therefore inquired whether it would not be redundant to send a resolution to the Ministry recommending certain work for which money had already been voted.

Gate Mudaliyar Wickremaratne replied that Mr. Sivapalan was correct and added that that resolution had been brought up by him at the Board on a previous occasion when it was postponed on the suggestion of a member that it should be discussed when the Director of Irrigation was present.

Mr. W. A. Guthrie, Director of Irrigation, said that funds had already been allocated to the Government Agents.

The Chairman said at this stage that as indicated by the previous speakers there was already provision in the budget for works of this nature. In the circumstances he inquired whether Gate Mudaliyar Wickremaratne still felt that the discussion of the resolution should go on.

Gate Mudaliyar Wickremaratne replied that he would like to ask the Director of Rural Development whether he had anything to say on the matter.

Mr. Sivapalan reiterated that there was no point in sending the resolution to the Ministry and asking for something which they had already provided. He said that the Director of Irrigation would be able to say that the money provided for was sometimes not fully utilised and that no amount of money asked for had been refused.

Gate Mudaliyar Wickremaratne went into the subject of explaining the difference between a Wanatha and a Pita-ela and said that there was nothing of that kind in Trincomalee.

Mr. D. B. Ellepola, Director, Rural Development, said that there were large votes provided for in the Land Commissioner's votes for getting work of that nature done. There was also provision in the Rural Development vote for assistance in that direction. He thought that even under the Soil Conservation Bill there was provision for a cultivator to be compensated when the conservation of his land was necessary and also the Minister could take action if that work was neglected by the cultivator. He advised Gate Mudaliyar Wickremaratne to watch developments after the Soil Conservation Bill was passed.

Gate Mudaliyar Wickremaratne accordingly withdrew his motion.

Item 6—A resolution to be moved by Mr. R. H. Spencer Schrader :—

"IT IS THE OPINION OF THIS BOARD THAT THE MINUTES OF MEETINGS, AS AT PRESENT RECORDED, ARE INORDINATELY LONG, AND THAT, IN FUTURE, THE MINUTES SHOULD CONTAIN ONLY A PRECIS OF THE MORE IMPORTANT POINTS RAISED IN DEBATE AND THE DECISIONS REACHED."

The above resolution was postponed in the absence of the mover.

Item 7—A resolution to be moved by Gate Mudaliyar N. Wickremaratne :—

"IN VIEW OF THE SHORT SUPPLY AND HIGH PRICES OF VEGETABLES PREVAILING IN MOST PARTS OF THE COUNTRY THIS BOARD SHALL DISCUSS THE MATTER AND RECOMMEND TO THE MINISTERS CONCERNED THE WAYS AND MEANS OF FACILITATING THE GREATER PRODUCTION, BETTER TRANSPORT AND EVEN DISTRIBUTION OF VEGETABLES AT A FAIR PRICE TO THE GROWERS AND THE CONSUMERS."

The Chairman read the resolution at the request of the mover and Mr. A. Hensman seconded the resolution. Mr. Hensman added that that motion had already been taken up at the District Agricultural Committee where Marketing Officers and the D. R. OO. were present.

Mr. K. Sittambalam, Acting Deputy Commissioner for Development of Marketing, said that he had been asked to bring to the notice of the Central Board of Agriculture that a Cabinet directive had been issued on July 20 :—

(*a*) that a temporary Co-operative Market for the sale of vegetables and other agricultural produce be erected on the site approved by the Colombo Municipality ;

(*b*) that the activities of the Marketing Department be expanded to collect all vegetables, fruits and other produce offered in all producing areas where their collection is not at present done by the Co-operative Production and Seles Societies ;

(*c*) that the sales to consumers be intensified by having sales units and preferably mobile vans to sell in every part of the city daily, during specified hours, of which due notice should be given.

He added that he would like to bring to the notice of the Board before they proceeded to discuss that resolution that the subject matter of the motion was identical with that of the Cabinet directive and that the action contemplated was the same. The Marketing Department had already proceeded to implement that directive and action had been taken to extend their collection scheme to a wider range than at present. At present collection vans were sent all over the Island to producing areas and the difficulty was that certain producing areas were not accessible by van or lorry. What they did was to help producers to find markets for their produce by contacting prospective buyers and putting them in touch with producers. Paying regard to the increased food production costs, they also assured the producer of a fair price for his commodity and enabled them to come together at a central spot by organising fairs at suitable places for marketing their produce. The Department also gave producers assistance by enabling them to sell their commodities at the Ceylon Products Shops. A number of those shops had been established in almost all the Municipal towns. After the Cabinent directive, the Department was also conducting van sales in Colombo, Kandy, Galle and Jaffna. The intention of the Department was to extend that service to provide wider and more intensive sales. He also wished to bring to the notice of the Board that the Department had already put up certain proposals for opening additional centres for collection of vegetables, &c. and for opening up sales centres where such commodities would be disposed of at a fair price. The problem now was that there was a seasonal shortage of certain varieties of vegetables, &c. and that remote producing areas were not easily accessible due to conditions that did not permit transport facilities. The Department was however endeavouring to contact producers in remote areas with the assistance of the Co-operative and the Rural Development Departments.

Gate Mudaliyar Wickremaratne said that providing marketing facilities, sending out marketing vans for collecting produce and giving facilities to the producer by organising Co-operatives, &c. was only one side of the question. The most important side was production and transport. To produce vegetables the grower should have facilities to grow. He was at one time an Honarary Information Officer to the Marketing Department and he wished he could continue the same work. His work was to find out the market price of different commodities. He emphasised that a pound of beans was selling in Colombo for 80 cents whereas the same variety in Kandy was selling for 35 cents. He asked whether the Marketing Department had inquired into that type of question. He said that anomaly was due to transport difficulties. A pound of tomatoes was selling in Colombo for Re. 1 whereas in Kandy it was only 45 cents a pound. He said that it was very essential that such anomalies should be investigated by the Department. The next thing that was vital to the grower was to see that he produced his commodity and sold it at a fair price. It should be inquired into whether the producer was now able to get a fair price for his commodity. He added that the difference in price of vegetables, &c. between Kandy and Colombo definitely showed that there was something wrong in the present system. He stated that there were many things that could be said about the Marketing Department but he had said enough. He wished that Government should

establish a scheme for the supply of proper seed and other planting material to the cultivator. Secondly he would suggest that in order to facilitate the growing of vegetables, the school garden system which was started in 1902 and abolished about the year 1924 or 1925 should be re-started so that seed, planting material, &c. might be sent to the school garden and the school garden might serve as a centre of distribution to the villages in the area. He said that it would also help the present generation to turn out good cultivators. He also suggested that Agricultural Instructors posted in different parts of the Island should be supplied with the necessary seed and planting material either for sale or free distribution. About thirty years ago the village garden had various kinds of vegetables unlike the present day. It was very necessary that planting material should be distributed among village cultivators and transport facilities should be made available. About two years ago he had visited a Co-operative Society at Welimada and their difficulty was lack of transport. If the Co-operative Department and the Marketing Department could work hand in hand both Departments would stand to benefit instead of the Marketing Department collecting their own vegetables.

Mr. Chas A. M. de Silva said that he had heard from a reliable source that in Kandy, spinach purchased at 2 cents per pound was being sold at 16 cents a pound.

Mr. Marcus S. Rockwood said that although the Cabinet directive on the subject was dated July 16, the A. G. A., Puttalam, had not been probably informed, and he was still not aware of such a directive.

Mr. K. Sittambalam, Acting Deputy Commissioner, Development of Marketing, in referring to the remarks of Gate Mudaliyar Wickremaratne said that administrative co-ordination between the Co-operative Department and the Marketing Department had already been established. The Marketing Department did not collect produce from the Co-operatives only, but also from where Co-operatives did not exist. The produce from every place where they had Co-operatives was collected, and the necessary liaison between the two Departments had been established. As regards the delay in giving effect to the Cabinet directive, he said it was too soon for any Department to expect full results on the directive. Proposals had already been submitted for collecting the necessary equipment for expediting marketing facilities, transport, sales as well as ensuring good prices.

Mr. S. Sivapalan referring to the resolution under discussion observed that there were two points that arose. One was ways and means of improving and facilitating greater production of vegetables. The other was providing marketing facilities. His personal opinion was that the Marketing Department served the interests of Colombo only whereas the outstations were not taken into consideration at all. As pointed out by several members the difference in price of vegetables in Colombo and Kandy compared with other outstations was several hundred per cent. more. He said that it was surprising that in spite of the various food production moves in the Island, still the people were starved of their vegetables. He was not aware when this country could be made self sufficient in vegetables and the most practical suggestion to make to Government was to see that this country was self sufficient in vegetables. The other point was that the system of distribution of vegetables in this country was not at all satisfactory. A pound of brinjal sold at Kandy for 15 cents was sold in a place like Trincomalee at 80 cents. If there was an efficient system of distribution there was no reason why the price should be so high in Trincomalee. He also remarked that the price of vegetables was a matter that affected seriously the cost of living of the people of this country and that was a resolution that had to be viewed in all its aspects. He also inquired whether with all the efforts that the Government had taken in regard to food production, they could say that in 1945 the country was 50 per cent.

short of vegetables whereas in 1950 it was only 30 per cent. short of vegetables. He said that besides that information they were even unable to say how much vegetables the country was able to produce. Twenty years ago every home had a kitchen garden. Today that practice had gone out of use. Unlike formerly a back garden attached to a home was a rare sight even in some of the outstation towns.

Mr. Sivapalan therefore suggested that a suitable Committee be appointed to go into the matter who should make practical suggestions and proposals so that Government could be urged to take action on such proposals.

At this stage the Chairman inquired whether those matters were not discussed at the District Agricultural Committee meetings. He added that improved methods of vegetable cultivation, &c. were matters that could easily be discussed at D. A. C. meetings. He requested the members to make it a special point to bring up that matter at their next D. A. C. meeting.

The Chairman added that the Department had done a good deal in regard to the supply of seed for vegetable cultivation. He said that the Botanist of the Department who was present at the meeting would be able to indicate to the Board what the Department had done in the way of making available to cultivators seed of improved varieties. He also said that Mr. De Mel who generally looked after the extension activities of the Department would offer information as to what the present policy of the Department was in regard to the promotion of vegetable cultivation.

Dr. M. F. Chandraratne, Botanist and Senior Agricultural Research Officer, stated that in regard to the breeding of superior strains of vegetables, the Department had within the last ten years evolved strains of vegetables in respect of practically every species that had grown in this country. The strains that had been selected were mainly for high yields in addition to cooking quality, resistance to disease, &c. They had also selected a new strain of bitter-gourd which could be guaranteed as resistant to fruit-fly. They had also a strain of cowpea which was very suitable for use as salad. They had received public acknowledgment of the satisfaction of the strains that had been selected.

As regards the actual multiplication and the issue of seed he would like to mention that they had only 40 acres of land for seed multiplication but that was not a very serious handicap because a number of Departmental stations were also in addition multiplying seed. Stations like Wagolla produced a large quantity of vegetable seed, especially that of bitter-gourd.

At this stage Mr. Clement Dias said that once he had applied for some seed to the Bandarawela Division and they had referred him to Peradeniya. He suggested that Departmental seed should be sold at every station. He added that up-country towns like Bandarawela were full of foreign vegetable seed whereas local seed was not to be seen. He said that sellers of vegetable seed usually had an agreement with the suppliers that whatever seed was unsold would be taken back. He suggested that the Department should also come to similar terms with sellers and make local seed available for sale. When foreign seed was sold for about 45 cents a packet he felt that local seed could easily be sold for about 20 or 25 cents a packet. He said that he was aware of the fact that the Department produced good seed but he was only requesting that better arrangements should be made for its disposal.

Mr. Sivapalan said that the question at issue was about supply and demand and that an account of the research the Department was carrying out in that direction had no relevance.

The Chairman replied that Gate Mudaliyar Wickremaratne had brought out the question of seed production and it would be useful for members to know what the Department was doing in that direction.

Mr. C. N. E. J. de Mel, Deputy Director of Agriculture, referring to a question raised about the District Agricultural Committee meetings said that he had seen in their minutes that the question of vegetable production had not been overlooked. He added that as the Botanist had already explained about the seed production in the Department he would not comment at length, but he would like to mention the fact that some years ago the Department spoke in terms of pounds in relation to the seed it produced but at present the Department was producing seed in hundredweight. Wagolla alone produced several hundredweight of seed, specially of bitter-gourd and luffa. As regards their distribution he said that Mahila Samiti and Rural Development Societies were supplied with seed from the Department. When the Department supplied seed to one Society that Society multiplies the seed and distributes to other centres so that the increase goes apace. Seed was available from several Agricultural Stations.

Regarding vegetables he said that members would be interested to know that exotic vegetables such as tomatoes were grown on some scale in Jaffna. The Divisional Agricultural Officer had recently indented a large quantity of seed from Australia and distributed seedlings raised by him to the people of the Peninsula. He said that that subject had been tackled on a very large scale compared to what it was sometime back. The Department had also introduced trials in potato growing which was making very good progress at the Bandarawela Potato Station. Potatoes were grown in Jaffna also.

At this stage Mr. S. Sivapalan proposed the following resolution and Mr. Clement Dias seconded :—

> "THAT THIS QUESTION OF VEGETABLE CULTIVATION AND MARKETING SHOULD BE REFERRED TO A SUB-COMMITTEE OF THIS BOARD FOR DETAILED CONSIDERATION."

This resolution was put to the House and carried.

The following members were elected to serve on the Committee, with Dr. M. F. Chandraratne (Botanist and Senior Agricultural Research Officer) as Convenor :—

Mr. Bandara Dharmakirti
Gate Mudaliyar N. Wickremaratne
Mr. Clement Dias
Mr. S. Sivapalan
Mr. R. T. Chelliah
Mr. D. B. Ellepola, D. R. D.
Mr. W. M. Cumaraswamy, and official members from the Co-operative, Marketing and Agricultural Departments to be co-opted.

The Chairman requested that this Committee should meet as early as possible.

The Chairman then declared the business of the meeting closed. Arrangements were then made for a cinephoto show conducted by Mr. A. M. Clement Dias. Mrs. Mendis read the commentary. The Chairman proposed a vote of thanks to Mr. Dias.

M. SIVANATHAN,
Secretary,
Central Board of Agriculture.

Peradeniya, October 18, 1951.

MINUTES OF THE MEETING OF THE BOARD OF THE TEA RESEARCH INSTITUTE OF CEYLON HELD AT 2.30 P.M. ON FRIDAY 7th SEPTEMBER, 1951, AT THE OFFICES OF THE PLANTERS' ASSOCIATION OF CEYLON, 113, STEUART PLACE, COLPETTY, COLOMBO

Present.—Mr. R. C. Scott, C.B.E. (Chairman) ; The Director of Agriculture (Dr. A. W. R. Joachim, M.B.E.) ; Messrs. W. Neal de Alwis, W. H. Attfield, R. M. Macintyre, A. D. McLeod, V. G. W. Ratnayake, M.P., M.B.E., Errol Jayawickreme, The Secretary to the Treasury (Mr. A. G. Ranasinha, C.M.G., C.B.E., C.C.S.) ; H. S. Hurst and G. B. Portsmouth (Acting Director and Secretary).

1. NOTICE CONVENING THE MEETING WAS READ

Letters and messages regretting inability to attend were received from the Chairman, Planters' Association of Ceylon (Mr. R. C. L. Notley), The Chairman, Agency Section, Planters' Association (Mr. R. S. Davies), Mr. L. B. de Mel and H. de T. Wilkinson Kay.

2. THE MINUTES OF THE MEETING OF THE BOARD HELD ON APRIL 20, 1951, WERE CONFIRMED WITHOUT COMMENT

3. MEMBERSHIP OF THE BOARD AND COMMITTEES

(*a*) *Board.*

The Chairman tabled a letter dated September 1, 1951, which he had received from Mr. L. B. de Mel tendering his resignation from the Board on account of ill-health. He expressed the appreciation of the Board for the keen interest and the very valuable contribution made by Mr. de Mel as a member. On behalf of the Board he expressed the earnest hope that Mr. de Mel would make a speedy recovery and soon be fit to resume normal activities.

(*b*) *Estate and Experimental Sub-Committee.*

The Chairman reported that at the meeting of the above Committee held on September 1, 1951, Mr. P. B. Cruickshank had intimated that he was proceeding on long leave. The Committee recommended the appointment of Mr. S. Bolster to fill the vacancy. Approved.

(*c*) *Mr. V. G. W. Ratnayake, M.P., M.B.E.*

The Chairman, on behalf of the other members of the Board, congratulated Mr. Ratnayake on his appointment as Parliamentary Secretary to the Minister of Posts and Telecommunications.

3——J. N. B 13344 (12/51)

4. FINANCE

(i) *Auditors' Report and Audited Accounts for 1950.*

The Chairman reported that a copy of the Auditors' Report and Accounts had been circulated. A memorandum on various points raised in the Report had also been sent out to members. The Report and Accounts had been carefully considered by the Finance Sub-Committee that morning. The Sub-Committee had unanimously recommended the acceptance of the Auditors' Report and Accounts.

He informed the members that the Institute's Balance Sheet was now presented in the form recommended by Mr. Kelly and accepted by the Board. It would be noted that the Capital Account was now incorporated in the Balance Sheet.

The Auditors' Report and Accounts for 1950 were accepted on the proposal of Mr. H. S. Hurst, seconded by Mr. R. M. Macintyre.

(ii) *T. R. I. Accounts to June 30, 1951.*

The Chairman reported that the cess collections had averaged Rs. 64,530 per mensem which was a very satisfactory figure.

He said that although the St. Coombs Estate Working Account showed a loss of Rs. 30,706·61 the true position was a profit of Rs. 21,782·50. This was so because the 27,984 lb. tea made in June but sold in July for Rs. 52,489·11 was not included in the account.

The Chairman announced that by the end of August, 1951, the yield of St. Coombs Estate had exceeded the total yield for the whole of 1950 by some 2,000 lb.

(iii) *Blister Blight Account.*

The Acting Director (Mr. G. B. Portsmouth) explained that the contribution of Rs. 150,000 for the year April 1, 1951 to March 31, 1952, could be expected as soon as a report on the past year's working had been sent to the Tea Controller.

5. SMALL HOLDING SERVICE

(i) *Extension of Small Holdings Service.*

The Chairman referred to the memorandum approved at the last meeting of the Board held on April 20, 1951, and which set out the plan for the proposed extension of the small holdings advisory service.

The Acting Director said that in order to put the recommendations embodied in the memorandum into effect without further delay a number of decisions should be taken by the Board. These fell into two categories, namely, Finance and Staff, and as the financial implications had already been considered by the Finance Sub-Committee he suggested that they should be dealt with first. The Finance Sub-Committee had, that morning, decided to recommend the following proposals for approval by the Board.

(*a*) The revenue from the extra cess of 5 cents per 100 lb. tea exported to be formally voted to the Small Holdings Service for administration by the Directors. The Director to have authority to transfer such amounts as he considered necessary to a Small Holdings Imprest Account, which would be operated on by the Officer-in-Charge of the Small Holdings Service.

(*b*) A sum of Rs. 45,000 from general revenue to be voted annually to augment the Small Holdings Account. In the current year the balance of the total vote for Small Holdings, as at the date from which the new cess became operative, to be transferred to the Small Holdings Account.

On the proposal of Mr. McLeod, seconded by Mr. Ratnayake, the financial proposals above were unanimously approved.

The Acting Director's proposals relating to staff were then considered.

It was agreed that Mr. R. L. Illankoon be appointed Officer-in-Charge of the new Small Holdings Service. Proposed by Mr. W. Neal de Alwis and seconded by Mr. H. S. Hurst.

The Acting Director had earlier in his remarks referred to Mr. R. L. Illankoon as an officer eminently suited to this new appointment in view of his long experience of this class of work.

The subject of the appointment of a permanent Sub-Committee which would be responsible to the Board for all matters pertaining to the working of the proposed Small Holdings Scheme was then taken up. It was unanimously agreed that the following should form the Sub-Committee :—Mr. V. G. W. Ratnayake (Member representing the Small Holders), Dr. A. W. R. Joachim (Director of Agriculture) and Mr. W. Neal de Alwis, together with the Director, T. R. I., and the Officer-in-Charge, Small Holdings Service.

6. LOW-COUNTRY SUB-STATION

The Chairman reported that the repairs to Pembroke bungalow were almost completed and that Mr. Walter was expected to be in occupation shortly.

7. ELECTRICITY SCHEME

The Chairman reported that in accordance with a previous decision of the Board the Government Electrical Engineer had been asked to report on the St. Coombs electricity supply service. A summary of his findings had been circulated to members. The Finance Sub-Committee had considered the matter that morning and their recommendation was that the 300 KVA scheme should be accepted, since this scheme would fully meet present needs and also provide for any expansion likely in the foreseeable future.

The recommendation of the Finance Sub-Committee was approved on the proposal of Mr. de Alwis, seconded by Mr. Hurst.

8. STAFF

Senior Staff.—The Chairman reported that :—

(*a*) the Superintendent, Mr. F. C. Daniel, had returned from leave and taken over charge of St. Coombs Estate on May 3, 1951 ;

(*b*) the Director, Mr. J. Lamb, had left St. Coombs on June 2, 1951, on home leave.

The meeting terminated with a vote of thanks to the Chair, proposed by Mr. Hurst.

G. B. PORTSMOUTH,
Acting Secretary.

Tea Research Institute of Ceylon,
St. Coombs, Talawakelle.

Rubber Research Scheme (Ceylon)

MINUTES OF THE 109TH MEETING OF THE RUBBER RESEARCH BOARD HELD AT THE PLANTERS' ASSOCIATION HEADQUARTERS, COLOMBO, AT 2.30 P.M., ON MONDAY, SEPTEMBER 3, 1951

Present.—Mr. F. H. Griffith (in the Chair), Mr. R. J. Hartley, Dr. A. W. R. Joachim (Director of Agriculture), Mr. F. A. Obeyesekera, Mr. J. L. D. Peiris, Senator C. Wijesinghe, Mr. R H. Wickremesinghe, C.C.S. (Controller of Establishments) and Dr. H. E. Young (Acting Director).

1. MINUTES

(*a*) *Confirmation*.—Draft minutes of the meeting held on August 20, which had been circulated to members, were signed by the Chairman as correct.

(*b*) *Matters arising from the minutes.*

Director.—It was agreed that Dr. H. E. Young, D.Sc., should be appointed Director, and the terms of the appointment were decided on. Dr. Young was asked to make his recommendations to the Board regarding the continuation of Oidium research and Mycological work.

2. BOARD

It was reported that Major Montague Jayewickreme, M.P., had resumed his seat on the Board relieving Major T. F. Jayawardena, M.P.

3. STAFF

Changes in staff since the last meeting were reported.

C. D. DE FONSEKA,
Secretary-Accountant.

Rubber Research Institute of Ceylon

MINUTES OF THE 110TH MEETING OF THE RUBBER RESEARCH BOARD HELD AT THE PLANTERS' ASSOCIATION HEADQUARTERS, STEUART PLACE, COLOMBO, AT 2.30 P.M. ON MONDAY, NOVEMBER 5, 1951

—

Present.—Mr. W. A. Paterson, Mr. Francis Amarasuriya, Major Montague Jayewickreme, M.P., Dr. A. W. R. Joachim (Director of Agriculture), Mr. R. J. Hartley, Mr. F. A. Obeyesekera Mr. J. L. D. Peiris, Mr. R. H. Wickremesinghe, C.C.S. (Controller of Establishments) and Dr. H. E. Young (Director, R. R. I.).

An apology for absence was received from Senator C. Wijesinghe.

The Vice-Chairman, Dr. H. E. Young, took the chair.

1. BOARD

Reported that Mr. F. H. Griffith had resigned on his departure from the island on retirement and that Mr. W. A. Paterson had been nominated in his place by the Planters' Association of Ceylon with effect from October 8, 1951.

Mr. Paterson was unanimously elected Chairman of the Board.

2. MINUTES

Draft minutes of the meeting held on September 3, 1951, which had been circulated to members, were confirmed and signed by the Chairman.

3. CHANGE OF NAME

It was reported that the amending Ordinance (Rubber Research Amendment Act, No. 30 of 1951) providing for the name of the institution being changed to Rubber Research Institute of Ceylon with effect from September 1, 1951, had been passed by Parliament.

4. DECISION BY CIRCULATION OF PAPERS

Appointment of Mycologist.—It was reported that all members had approved the appointment of Ir. J. H. Van Emden as Oidium Research Officer and Mycologist. He had accepted the appointment and was expected to arrive in Ceylon early in December.

5. EXPERIMENTAL COMMITTEE

Recommendations made at meeting held on September 29, 1951:

(*a*) *Visiting Agent's Report.*—Supplementary votes as recommended by the Committee were passed to provide for extra expenditure to be incurred on weeding and diseases.

(*b*) *Purchase of clonal seed and seedlings.*—A supplementary vote of Rs. 5,600 was passed to cover the cost of clonal seeds and seedlings to be purchased for 1953 planting.

(*c*) *Research Programme for 1952.*—The draft research programme for 1952 was approved.

1. Overseas Training for Graduate Research Assistants.

The Director's suggestions for the overseas training of the three Research Assistants who are now in training at Dartonfield were considered and approved.

2. Smallholdings Department.

Matters of policy in regard to the work of the Smallholdings Department were discussed and the extent of its relations with certain Government Departments was defined. The Smallholdings Propaganda Officer came into the meeting during the consideration of this item.

Mr. Wickremesinghe left the meeting.

(*d*) *Contracts for labourers' cottages.*—Agreed that contracts for the construction of 8 labourers' cottages at Hedigalla and 4 at Dartonfield be awarded to the two contractors who are at present working on these two estates.

The minutes were adopted subject to the above comments.

Mr. J. L. D. Peiris left the meeting.

6. REPORTS AND ACCOUNTS

(*a*) *Balance Sheet and Auditor-General's Report for 1950* were approved and covering sanction was given for the over-expenditure on the year's votes as specified in the Auditor's Report.

(*b*) *Statement of Receipts and Payments for the 2nd Quarter 1951* was approved.

(*c*) *Estate Accounts for 1st and 2nd Quarters 1951* were tabled.

(*d*) *Draft Estimates for 1952.*—Draft Estimates for 1952, providing for income and expenditure as follows, were approved :

			Rs.
Estimated income ..	..	..	1,610,129
Estimated expenditure			
	Rs.		
Revenue ..	959,482	..	
Capital ..	321,020		
			1,280,502
Estimated excess of income over expenditure		..	329,627

7. STAFF

(*a*) *Botanist.*—Agreed that Mr. C. A. de Silva, Botanist, be re-engaged for a further term of 4 years on the termination of his present contract in February, 1952.

(*b*) *Small-holdings Propaganda Officer.*—Agreed that Mr. W. I. Pieris, Small-holdings Propaganda Officer, be re-engaged for a further term of 4 years on the termination of his present contract in March, 1952.

8. EXCHANGE OF BUDWOOD

Reported that budwood of certain local and other clones had been sent to the Institut Des Recherches Sur Le Caoutchouc En Indochine, Indochina, in exchange for budwood of some of their clones. Proposed arrangements for the distribution of material of these clones on either side were considered and approved.

9. LONDON ADVISORY COMMITTEE FOR RUBBER RESEARCH (CEYLON AND MALAYA)

(*a*) *Contribution for 1952.*—It was agreed that the contribution for 1952 should be the same as for the current year.

(*b*) *Minutes.*—Minutes of the 53rd meeting of the Committee and Technical Sub-Committee and the 1st meeting of the Latex Sub-Committee were tabled.

10. PUBLICATIONS

The Annual Report for 1950 and Advisory Circular No. 30 were tabled.

Before the meeting ended Mr. Hartley expressed the thanks of the Board to its previous Chairman, Mr. F. H. Griffith, for his valuable services as a member for 21 years and as Chairman since June, 1950.

C. D. DE FONSEKA,
Secretary-Accountant,

RETURNS ETC.

SUMMARY OF OUTBREAKS OF SCHEDULED ANIMAL DISEASES WITHIN THE DOMINION OF CEYLON—MONTH ENDED AUGUST 31, 1951

Province	Disease	Fresh cases during the month	Total number from the beginning of this calendar year to August 31, 1951				Balance ill at end of month
			Cases	Deaths	Shot	Recoveries	
Western Province	Foot-and-Mouth	—	25	—	—	25	—
	Rabies	1	6	6	—	—	—
Colombo Municipality	Foot-and-Mouth	51	85	—	—	34	51
	Anthrax	—	7	7	—	—	—
	Tuberculosis	3	11	11	—	—	—
	Piroplasmosis	—	6	6	—	—	—
	Haemorrhagic Septicaemia	—	1	1	—	—	—
	Rabies	12	45	45	—	—	—
Quarantine Station	Piroplasmosis	—	3	3	—	—	—
	Anthrax (in Sheep and Goats)	13	38	38	—	—	—
	Pleuro-Pneumonia	—	101	101	—	—	—
Northern Province	Pleuro-Pneumonia	—	38	38	—	—	—
	Rabies	1	10	—	10	—	—
	Anthrax	—	6	6	—	—	—
	Foot-and-Mouth	193	246	—	1	196	49
	Black Quarter	164	745	745	—	—	—
North-Central Province ..	Foot-and-Mouth	167	1,212	5	—	994	213
North-Western Province	Rabies	—	2	—	2	—	—
	Foot-and-Mouth	—	49	2	—	47	—
	Black Quarter	—	3	3	—	—	—
Central Province	Mange (cattle)	26	202	12	—	148	42
	Foot-and-Mouth	—	348	1	—	347	—
	Piroplasmosis	—	2	—	—	2	—
	Black Quarter	—	14	14	—	—	—
Province of Sabaragamuwa	Piroplasmosis	—	1	—	—	1	—
	Rabies	1	6	—	6	—	—
Province of Uva	Black Quarter	—	11	11	—	—	—
	Rabies	—	6	3	3	—	—
Eastern Province ..	Rabies	—	5	1	4	—	—
Southern Province	Anaplasmosis	—	1	—	—	1	—
	Rabies	3	8	—	8	—	—

Department of Agriculture,
Peradeniya, Ceylon,
October 4, 1951.

T. M. Z. MAHAMOOTH,
Deputy Director (Animal Husbandry)
and Government Veterinary Surgeon.

SUMMARY OF OUTBREAKS OF SCHEDULED ANIMAL DISEASES WITHIN THE DOMINION OF CEYLON—MONTH ENDED SEPTEMBER 30, 1951

Province	Disease	Fresh cases during the month	Total number from the beginning of this calendar year to September 30, 1951				Balance ill at end of month
			Cases	Deaths	Shot	Recoveries	
Western Province	Foot-and-Mouth	49	74	—	—	25	49
	Rabies	—	6	6	—	—	—
Colombo Municipality	Foot-and-Mouth	5	90	—	—	85	5
	Anthrax	—	7	7	—	—	—
	Tuberculosis	—	11	11	—	—	—
	Piroplasmosis	—	6	6	—	—	—
	Haemorrhagic Septicaemia	—	1	1	—	—	—
	Rabies	6	51	51	—	—	—
Quarantine Station	Piroplasmosis	—	3	3	—	—	—
	Anthrax (in sheep and goats)	2	40	40	—	—	—
	Pleuro-Pneumonia	17	118	118	—	—	—
Northern Province	Pleuro-Pneumonia	—	38	38	—	—	—
	Rabies	2	12	—	12	—	—
	Anthrax	—	6	6	—	—	—
	Foot-and-Mouth	88	334	—	1	333	—
	Black Quarter	39	784	784	—	—	—
North-Central Province	Foot-and-Mouth	—	1,212	5	—	1,207	—
	Black Quarter	68	68	68	—	—	—
North-Western Province	Rabies	—	2	—	2	—	—
	Foot-and-Mouth	—	49	2	—	47	—
	Black Quarter	—	3	3	—	—	—
Central Province	Mange (cattle)	31	233	15	—	200	18
	Foot-and-Mouth	—	348	1	—	347	—
	Piroplasmosis	—	2	—	—	2	—
	Black Quarter	—	14	14	—	—	—
Province of Sabaragamuwa	Rabies	—	6	—	6	—	—
	Piroplasmosis	—	1	—	—	1	—
Province of Uva	Black Quarter	—	11	11	—	—	—
	Rabies	4	10	5	5	—	—
Eastern Province ..	Rabies	—	5	1	4	—	—
Southern Province	Anaplasmosis	—	1	—	—	1	—
	Rabies	—	8	—	8	—	—

Department of Agriculture,
Peradeniya, Ceylon,
October 30, 1951.

T. M. Z. MAHAMOOTH,
Deputy Director (Animal Husbandry)
and Government Veterinary Surgeon.

4——J. N. B 13344 (12/51)

SUMMARY OF OUTBREAKS OF SCHEDULED ANIMAL DISEASES WITHIN THE DOMINION OF CEYLON—MONTH ENDED OCTOBER 31, 1951

Province	Disease	Fresh cases during the month	Total number from the beginning of this calendar year to October 31, 1951				Balance ill at end of month
			Cases	Deaths	Shot	Recoveries	
Western Province	Foot-and-Mouth	4	78	—	—	74	4
	Rabies	—	6	6	—	—	—
Colombo Municipality	Foot-and-Mouth	—	90	—	—	90	—
	Anthrax	—	7	7	—	—	—
	Tuberculosis	—	11	11	—	—	—
	Piroplasmosis	—	6	6	—	—	—
	Haemorrhagic Septicaemia	—	1	1	—	—	—
	Rabies	6	57	57	—	—	—
Quarantine Station	Piroplasmosis	—	3	3	—	—	—
	Anthrax (in sheep and goats)	16	56	56	—	—	—
	Pleuro-Pneumonia	8	126	126	—	—	—
Northern Province	Pleuro-Pneumonia	—	38	38	—	—	—
	Rabies	2	14	—	14	—	—
	Anthrax	—	6	6	—	—	—
	Foot-and-Mouth	—	334	—	1	333	—
	Black Quarter	336	1,120	1,120	—	—	—
North-Central Province	Foot-and-Mouth	—	1,212	5	—	1,207	—
	Black Quarter	—	68	68	—	—	—
North-Western Province	Rabies	—	2	—	2	—	—
	Foot-and-Mouth	—	49	2	—	47	—
	Black Quarter	—	3	3	—	—	—
Central Province	Mange (cattle)	28	261	21	—	218	22
	Foot-and-Mouth	—	348	1	—	347	—
	Piroplasmosis	—	2	—	—	2	—
	Black Quarter	—	14	14	—	—	—
Province of Sabaragamuwa	Rabies	1	7	1	6	—	—
	Anaplasmosis	—	1	—	—	1	—
Province of Uva	Black Quarter	—	11	11	—	—	—
	Rabies	1	11	5	6	—	—
Eastern Province	Rabies	—	5	1	4	—	—
	Foot-and-Mouth	19	19	—	—	5	14
Southern Province	Anaplasmosis	—	1	—	—	1	—
	Rabies	—	8	—	8	—	—

Department of Agriculture,
Peradeniya, Ceylon,
December 8, 1951.

T. M. Z. MAHAMOOTH,
Deputy Director (Animal Husbandry)
and Government Veterinary Surgeon.

METEOROLOGICAL REPORT, AUGUST, 1951

STATION	TEMPERATURE				HUMIDITY		Amount of Cloud	RAINFALL		
	Mean Maximum	Offset	Mean Minimum	Offset	Day	Night (from Minimum)		Amount	No. of Rainy Days	Offset
	°	°	°	°	%	%		in.		in.
Agalawatta	—	—	—	—	—	—	—	—	—	—
Anuradhapura	94·0	+2·7	76·0	+0·4	59	88	4·2	0·91	4	— 0·71
Badulla	87·5	+1·5	63·6	—0·9	60	94	4·4	4·02	6	+ 0·82
Batticaloa	91·0	+0·6	76·4	—0·1	67	79	5·0	0·17	2	— 1·78
Colombo	85·8	+1·0	78·1	+1·2	76	86	6·4	0·13	7	— 3·90
Diyatalawa	79·1	+1·3	60·7	—1·1	61	83	5·4	1·99	5	— 1·13
Galle	83·3	+0·7	76·3	—0·4	75	82	5·2	2·88	12	— 3·26
Hambantota	88·1	+1·2	76·9	+0·8	72	86	5·0	0	0	— 1·44
Jaffna	87·6	+1·6	80·1	+0·9	77	85	5·2	0·40	2	— 0·71
Kandy	87·0	+3·8	70·3	+0·2	68	80	5·7	1·05	9	— 4·68
Kankesanturai	91·5	—	79·6	—	67	87	5·8	0·95	3	—
Kurunegala	88·7	+1·9	75·6	+0·8	66	84	5·5	0·08	4	— 3·54
Mannar	88·3	+1·0	79·0	+0·4	76	86	5·2	0	0	— 0·66
Nuwara Eliya	68·2	+2·2	53·2	—1·1	80	91	6·8	2·64	15	— 4·87
Puttalam	87·7	+1·4	77·9	0	73	86	5·4	0	0	— 0·65
Ratmalana	85·6	—	77·5	—	74	82	6·0	0·11	7	— 3·37
Ratnapura	89·8	+3·2	74·6	—0·4	68	88	5·9	1·18	13	—10·21
Talawakele	73·9	+3·0	58·6	—0·6	78	88	5·4	2·71	19	— 7·37
Trincomalee	93·5	+1·5	77·3	0	62	80	5·4	1·97	3	— 1·64

WEATHER SUMMARY, AUGUST, 1951

Exceptionally dry weather prevailed over the south-western parts of the Island in August. The area worst affected was the south-western hill-country where the highest totals recorded barely exceeded 5 inches, as against averages ranging from 15 to 25 inches. In fact, for several stations there the rainfall last month was the lowest on record. Thus, 2·06 inches at Blair Athol Estate, Dickoya, was the lowest total in 73 years, the previous lowest being 2·54 inches in 1898. Similarly, 3·56 inches at Abergeldie Group, Rozelle, and 2·26 inches at Dunsinane Estate, Pundalu Oya, were the lowest in 67 and 65 years, respectively. The previous lowest totals at these two stations also occurred in 1898, 4·07 inches at Abergeldie and 3·09 inches at Dunsinane. Watawala which is normally one of the wettest stations in August also recorded its lowest total in 40 years last month, i.e., 5·34 inches (as against an average of 25·85 inches). The previous lowest total at this station was 9·20 inches in 1927. The only days on which this region received any widespread, appreciable rain were the 21st and 22nd.

Outside the south-west quarter, too, the weather was mostly dry, but the north-eastern parts experienced rain, accompanied by thunder, on a few days, particularly from 11th to 14th and from 23rd to 25th. On the 13th the rainfall was appreciably heavy and widespread in the North-Central Province and in the lee of the hills, a number of stations recording falls over an inch. Areas that did not receive any rain in August were the Mannar District, a major portion of North-Western Province and the south-eastern low-country.

The biggest totals recorded were 9·26 inches at Hendon Estate, 8·19 inches at Sandringham Estate, 7·21 inches at Ohiya and 6·83 inches at Norton Bridge.

The rainfall was below normal except at a few stations in the lee of the hills. The larger deficits, of the order of 10 to 20 inches, occurred on the south-western slopes of the hills and the adjacent mid-country, the outstanding amounts being 20·51 inches at Watawala, 20·32 inches at Norton Bridge, 19·39 inches at Kenilworth Estate and 18·68 inches at Blackwater Estate. The greatest excesses were 5·66 inches at Hendon Estate, 3·73 inches at Ohiya 34·8 inches at Iranaimadu and 3·41 inches at Horaborawewa.

There were no daily falls of five inches or over in August. The highest daily fall for the month was 4·10 inches at Hendon Estate on the 13th.

A severe hailstorm was reported from Nawagattegama in Puttalam District on the 25th.

Day temperatures were well above normal at inland stations and a little above normal elsewhere. Night temperatures did not deviate much from average. The highest recorded temperature in the shade was 98·2°, at Batticaloa on the 5th, while the lowest temperature for a low-country station was 69·9° at Ratnapura on the 29th. The lowest temperature for the whole Island was 45·8° at Nuwara Eliya on the 27th. The mean day humidity varied from 70 to 80 per cent. in the wet zone and from 60 to 70 per cent. in the dry zone. The night humidity ranged mainly from 80 to 90 per cent. The cloud amounts were generally about normal. The wind was about the average strength, the prevailing direction being south-westerly.

D. T. E. DASSANAYAKE,
Director.

5 —J. N. B 13344 (12/51)

METEOROLOGICAL REPORT, SEPTEMBER, 1951

STATION	TEMPERATURE				HUMIDITY		Amount of Cloud	RAINFALL		
	Mean Maximum	Offset	Mean Minimum	Offset	Day	Night (from Minimum)		Amount	No. of Rainy Days	Offset
	°	°	°	°	%	%		in.		in.
Agalawatta	—	—	—	—	—	—	—	—	—	—
Anuradhapura	92·3	+0·6	74·4	—0·8	65	93	5·4	10·24	15	+ 6·48
Badulla	85·1	—0·5	64·9	+0·6	64	92	4·9	4·13	14	— 0·36
Batticaloa	89·3	—0·5	76·5	+0·3	70	84	5·8	0·72	2	— 1·67
Colombo	86·6	+1·3	76·2	—0·5	76	88	6·5	12·97	20	+ 6·13
Diyatalawa	77·7	—0·1	60·8	—0·2	71	89	5·9	7·23	18	+ 2·82
Galle	83·2	+0·4	76·0	—0·7	74	79	5·8	12·92	23	+ 4·11
Hambantota	85·6	—1·0	75·7	—0·5	80	91	6·0	3·47	10	+ 0·71
Jaffna	87·7	+1·5	80·0	+0·8	76	82	5·0	2·94	5	+ 0·41
Kandy	86·3	+2·1	69·6	+0·3	71	92	5·5	10·96	20	+ 4·52
Kankesanturai	90·1	—	79·3	—	71	85	5·6	0·69	3	—
Kurunegala	88·9	+1·4	74·1	—0·2	68	88	5·8	14·49	20	+ 8·94
Mannar	88·5	+0·8	78·6	—0·2	75	84	5·4	3·35	7	+ 2·11
Nuwara Eliya	67·3	0·6	52·8	—0·4	85	94	6·6	9·79	22	+ 1·55
Puttalam	87·4	+0·7	76·7	—1·3	74	88	5·9	14·38	16	+12·80
Ratmalana	86·4	—	75·3	—	73	86	6·2	16·67	22	+ 9·83
Ratnapura	89·2	+2·2	73·4	—0·2	73	93	6·4	17·54	25	+ 3·02
Talawakele	73·7	+1·6	58·2	—0·1	84	91	5·0	13·29	24	+ 3·54
Trincomalee	90·8	+1·3	77·4	+0·3	65	82	5·7	2·44	6	— 0·99

WEATHER SUMMARY, SEPTEMBER, 1951

Rainfall in September was considerably above normal in the western and south-western parts of the Island. Larger excesses (of the order of 10 to 15 inches) were found scattered, the highest being 15·51 inches at Galgamuwa, 14·70 inches at Maho and 14·04 inches at Palavi, all in the North-Western Province, and 14·76 inches at St. Leonard's Estate and 14·54 inches at Anningkande Estate, in the south-west. Excesses in the North-Western Province were significant, because the actual rain received (about 15 inches) was several times the average for the month (2 to 3 inches). For some long-standing stations there, the rainfall last month was the highest on record. Thus, 14·38 inches at Puttalam was the highest total for September in 82 years, the previous highest being 8·31 inches in 1877. Similarly 18·21 inches at Galgamuwa and 16·18 inches at Mediyawa were the highest September totals in 42 and 46 years, respectively.

Deficits which were small, were found chiefly in the eastern and north-eastern coastal areas. The only deficit over 5 inches was 5·54 inches at Hapugastenne Estate.

Rainfall was heaviest in the south-west quarter where the monthly totals generally exceeded 15 inches, the highest being 30·07 inches at Norton Bridge, 28·30 inches at Theydon Bois Group, 27·57 inches at Massena and 26·89 inches at Kellie Estate. Rangala area, on the north-eastern slopes of the hills, also received over 15 inches, Nilloomally Estate recording a total of 25·78 inches. Least rain was experienced along the eastern and south-eastern coasts where the monthly totals were generally below 2 inches.

During the early part of the month the weather was mainly warm and dry. Thunderstorms which commenced on the 12th lasted till about the 24th, giving afternoon or evening rains which were considerably heavy and wide-spread from the 18th to 21st. From about the 25th the weather became unsettled, and continued so till the end of the month. During this period rain was fairly widespread over the Island, and considerably heavy on the south-western slopes of the hills. Squally weather resulted in some damage to house and property, and interruptions to telephone and telegraphic services. The anamometer at the Colombo Pilot Station recorded several squalls exceeding gale force (38 m.p.h.) from the 27 to 29th.

There were 16 daily falls of five inches or over in September, the highest being 7·24 inches at St. Leonard's Estate on the 24th.

Day temperatures were above normal in the west and below normal in the east. Night temperatures were, on the whole, a little below normal. The highest temperature recorded in the shade was 97·2° at Trincomalee on the 2nd, while the lowest temperature for a low-country station was 70·4° at Ratnapura, also on the 2nd. The lowest temperature for the whole Island was 47·8° at Nuwara Eliya on the 19th. The mean day humidity varied generally from 65 to 80 per cent. and the mean night humidity from 85 to 95 per cent. The skies were markedly cloudy, particulary during the second half of the month. The wind was slightly below average strength, the mean direction being south-westerly.

D. T. E. DASSANAYAKE,
Director.

METEOROLOGICAL REPORT, OCTOBER, 1951

STATION	TEMPERATURE				HUMIDITY		Amount of Cloud	RAINFALL		
	Mean Maximum	Offset	Mean Minimum	Offset	Day.	Night (from Minimum)		Amount	No. of Rainy Days	Offset
	°	°	°	°	%	%		in.		in.
Agalawatta	—	—	—	—	—	—	—	—	—	—
Anuradhapura	89·5	+0·5	74·3	+0·8	72	93	5·4	7·50	9	— 2·22
Badulla	84·5	+1·7	65·8	+0·4	65	92	4·7	11·06	11	+ 2·17
Batticaloa	87·4	+0·4	76·6	+1·4	74	88	4·8	1·77	7	— 5·42
Colombo	85·9	+1·0	75·7	+0·9	80	91	6·2	7·73	19	— 5·98
Diyatalawa	77·8	+1·6	60·2	—0·4	72	91	5·8	9·16	17	— 0·02
Galle	84·1	+1·1	75·9	+0·5	72	79	5·4	4·36	17	— 7·69
Hambantota	86·0	—0·2	76·0	+0·7	79	90	5·7	1·60	10	— 3·16
Jaffna	86·6	+0·9	79·3	+1·8	78	85	5·4	7·72	9	— 1·48
Kandy	85·3	+0·5	69·0	+0·5	74	95	5·6	12·96	19	+ 2·42
Kankesanturai	88·8	—	78·5	—	72	86	5·4	4·29	4	—
Kurunegala	87·7	+0·4	73·9	+0·7	73	88	4·8	10·37	21	— 4·49
Mannar	88·0	+1·1	78·7	+1·5	76	86	5·3	2·92	4	— 3·66
Nuwara Eliya	68·9	+1·3	51·6	—0·3	80	91	7·0	7·85	22	— 1·91
Puttalam	86·0	—0·2	76·5	+1·0	77	91	5·4	5·06	14	— 2·37
Ratmalana	86·0	—	75·3	—	72	86	6·2	6·50	20	— 6·70
Ratnapura	88·9	+1·9	73·1	+0·3	74	93	6·2	22·89	22	+ 4·88
Talawakele	73·9	+0·6	57·8	+0·1	81	91	5·1	8·46	23	— 1·60
Trincomalee	90·2	+2·4	76·3	+0·8	69	91	5·8	8·11	9	— 1·44

WEATHER SUMMARY, OCTOBER, 1951

The rainfall in October was appreciably below normal over a large portion of the Island. The bigger deficits, of the order of 5 to 10 inches, occurred in the western and south-western low-country, in Jaffna Peninsula and along the north-east coast, the biggest deficits being 12·24 inches at Rambukkana, 10·83 inches at Kottawa (Galle), 10·80 inches at Baddegama Estate and 10·60 inches at Poramadala. Excesses (which were small) occurred mainly among and around the central hills. A few stations recorded excesses over 5 inches, the highest being 8·99 inches at Matale and 7·42 inches at Maliboda Estate.

The rainfall was heaviest on the south-western slopes of the hills and the adjacent mid-country, where several stations recorded totals exceeding 20 inches, the outstanding amounts being 32·13 inches at Maliboda Estate, 30·15 inches at Padupola, 29·71 inches at Watawala, 28·85 inches at Blackwater Estate and 28·60 inches at Kenilworth Estate. Outside this area there was a gradual decrease in rainfall, and the monthly totals in the north and east were mainly below 5 inches. Least rain (totals below 2 inches) was experienced in limited areas in Jaffna Peninsula and along the coast in the north-west, east and south-east.

Unsettled conditions in September continued into October, giving fairly general rain in the south-western parts and neighbourhood till about the 11th. On the 10th the rainfall was considerably heavy, several stations recording amounts over 3 inches. This was followed by a spell of 6 days of unusually bright and dry weather with hardly any rain anywhere over the Island. Local thundershowers that set in thereafter continued till the end of the month. They were widely experienced, with considerably heavy rain, on the 22nd and again from the 27th to 30th.

There were 20 daily falls of five inches or over in October, the highest being 7·06 inches at Avissawella Estate on the 28th.

Temperatures were appreciably above normal, both by day and by night. The highest recorded temperature in the shade was 94·2° at Trincomalee on the 6th, while the lowest temperature in the low-country was 70·5°, at Anuradhapura on the 26th and at Ratnapura on the 16th and 23rd. The lowest temperature for the whole Island was 42·6° at Nuwara Eliya on the 14th. The mean day humidity varied from 70 to 80 per cent. and the mean night humidity from 85 to 95 per cent. The cloud amounts were a little above average. The wind was also above the average strength, the mean direction being mainly south-westerly.

D. T. E. DASSANAYAKE,
Director.

METEOROLOGICAL REPORT, NOVEMBER, 1951

STATION	TEMPERATURE				HUMIDITY		Amount of Cloud	RAINFALL		
	Mean Maximum	Offset	Mean Minimum	Offset	Day	Night (from Minimum)		Amount	No. of Rainy Days	Offset
	°	°	°	°	%	%		in.		in.
Agalawatta	—	—	—	—	—	—	—	—	—	—
Anuradhapura	87·0	+1·3	72·6	+1·0	80	95	5·8	13·28	21	+ 2·61
Badulla	79·8	+0·5	66·6	+1·1	78	95	6·3	11·68	24	+ 1·43
Batticaloa	85·3	+1·2	75·0	+0·7	78	93	4·9	11·08	18	— 2·78
Colombo	85·3	0	73·8	+0·4	78	93	6·0	23·22	24	+10·13
Diyatalawa	75·8	+1·8	60·6	+0·7	82	97	6·4	10·86	26	+ 0·44
Galle	84·6	+1·1	74·8	+0·5	79	90	5·6	8·35	19	— 3·66
Hambantota	86·5	+1·2	74·7	+0·7	78	92	5·6	8·43	16	+ 0·86
Jaffna	85·2	+1·2	75·7	+0·9	80	91	5·8	15·20	21	— 2·07
Kandy	84·1	+0·2	68·4	+0·3	76	95	6·0	13·22	19	+ 2·20
Kankesanturai	85·2	—	76·1	—	78	88	6·0	12·87	21	—
Kurunegala	87·2	+0·2	72·6	+0·7	74	90	5·4	15·14	20	+ 2·75
Mannar	84·9	+0·3	76·0	+0·4	82	91	5·9	9·72	21	— 0·47
Nuwara Eliya	67·9	+0·2	52·0	+0·8	83	94	6·6	10·65	20	+ 1·46
Puttalam	85·6	0	73·8	+0·6	80	93	5·6	12·01	19	+ 1·88
Ratmalana	85·8	—	72·9	—	74	90	6·1	23·86	22	+11·74
Ratnapura	88·8	+1·2	72·5	+0·1	74	93	6·7	16·72	17	+ 1·93
Talawakele	73·8	+0·2	57·8	+0·5	84	94	5·4	11·08	19	+ 2·58
Trincomalee	84·5	+1·0	74·9	+0·1	78	90	5·8	16·44	19	+ 2·50

WEATHER SUMMARY, NOVEMBER, 1951

The weather over the Island was influenced by two mild depressional movements in November. The one in the Arabian Sea was responsible for the heavy and widespread rain on the 11th, while the other in the Bay of Bengal was responsible for the heavy rain which was widespread on the 16th, but confined to the northern and north-central parts only on the 17th. On the 11th and the 16th, daily falls over 3 inches were recorded at a large number of stations distributed over the Island.

During the rest of the month, afternoon or evening thunderstorms were much in evidence, resulting in fairly general rain. Bright and dry weather prevailed from 22nd to 24th.

The monthly totals at a majority of stations ranged from 10 to 15 or 15 to 20 inches. Stations which registered higher aggregates were found distributed mainly around the central hills. The greatest total recorded was, however, 32·22 inches at Ramanathan College, Jaffna. Other outstanding toals were 30·83 inches at Pussella Estate, 30·15 inches at Weweltalawa Group, 29·41 inches at Kanangama Estate, 28·43 inches at Keragala Estate and 28·38 inches at Nagrak Estate. Least rain was experienced along the southern and south-eastern coasts, where the monthly totals were less than 10 inches.

Deviation of rainfall from average has been rather irregular, appreciable excesses being found side by side with appreciable deficits. Excesses, however, predominated, the larger excesses occurring mainly around the central hills, where the totals at Mahawalatenna and Nagrak Estate were above average by 14·35 and 13·66 inches, respectively. The rainfall at Ramanathan College was also in excess of the average by 13·97 inches. Deficits were found mainly in the Northern and the Southern Provinces, and in Batticaloa District, the biggest deficits being 8·45 inches at Carney Estate, 7·11 inches at Pallai and 7·09 inches at Paranthan.

There were 13 daily falls of 5 inches or over in November, a majority of them occurring on the 11th or on the 16th. The highest were 9·26 inches at Mahawalatenna on the 25th and 8·23 inches at Horana on the 11th.

Heavy mist was experienced at Colombo on the morning of the 9th.

Temperatures were appreciably above normal, both by day and by night. The highest recorded temperature in the shade was 92·1° at Ratnapura on the 25th, while the lowest temperature in the low-country was 67·9° at Kurunegala on the 12th. The lowest temperature for the whole Island was 43·2° at Nuwara Eliya on the 23rd. The mean day humidity varied from 75 to 85 per cent. and the mean night humidity from 90 to 95 per cent. The skies were more cloudy than usual, particularly in the afternoon. The wind was slightly below the average strength, the direction being variable.

D. T. E. DASSANAYAKE,
Director.

List of New Acquisitions to the Library, Department of Agriculture, for the Period January 1 to March 31, 1950

BOOKS

1. Braverman, J. B. S.—Citrus Products.
2. Barnes, H. F.—Gall Midges of Miscellaneous Crops.
3. King, F. H.—Farmers of Forty Centuries (Issued to Divisional Agricultural Officer, Bandarawela).
4. Statistical Abstract of Ceylon, 1949.
5. Wadia, D. N.—Geology of India, 2nd Edition (Issued to Girls' Farm School, Kundasale).
6. Woody Plant Seed Manual—United States Department of Agriculture.
7. Von Loesecke—Bananas.
8. Wadia, D. N.—Department of Mineralogy, Professional Papers I & II.
9. Guide to Scientists in Indonesia.
10. McMeekan et al.—Principles of Animal Production.
11. Lipscomb, A. W. G.—Breeding and Management of Livestock, 4th Edition.
12. Lipscomb, A. W. G.—Breeding and Management of Livestock, 4th Edition (Issued to Girls' Farm School, Kundasale).
13. Lowry and Cavell—Intermediate Chemistry, 5th Edition (Issued to Girls' Farm School, Kundasale).
14. Hall, A. D.—Fertilizers and Manures, 4th Edition (Issued to Girls' Farm School, Kundasale).
15. Brimble, L. J. F.—Intermediate Botany, 3rd Edition (Issued to Girls' Farm School, Kundasale).
16. Hall, A. D.—The Soil, 4th Edition.
17. Eckles, C. H.—Dairy Cattle and Milk Production, 3rd Edition (Issued to Girls' Farm School, Kundasale).
18. Ceylon Year Book, 1949.
19. Morrison, I. G.—Repairing Farm Machinery.
20. Whyte, R. O.—Crop Production and Environment (Issued to Agricultural Research Officer, South Eastern, Hambantota).
21. Whyte, R. O.—Crop Production and Environment.
22. Rhind, D.—Notes on the Improvement of the Yields of Paddy in Ceylon.
23. Clayton, E. E. S.—Soil Erosion and its Control.
24. Conserve Your Soil—by Bank of New South Wales.
25. Stockdale, F. A.—Report on a Visit to Fiji.
26. Haldane and Huxley—Animal Biology.
27. Soil Conservation on the Farms—by New South Wales Department of Soil Conservation.
28. Soil Science Society of America, Proceedings, 1948.
29. Domestic Preservation of Fruit and Vegetables, 7th Edition—by Ministry of Agriculture and Fisheries (Issued to Girls' Farm School, Kundasale).
30. Fermor, C. E.—Good Poultry Keeping.
31. Fermor, C. E.—Good Poultry Keeping (Issued to Girls' Farm School, Kundasale).
32. Paterson, J. D.—Good and Healthy Animals.
33. Paterson, J. D.—Good and Healthy Animals (Issued to Girls' Farm School, Kundasale).
34. Robinson, H. G.—Good Milk Farming.
35. Robinson, H. G.—Good Milk Farming (Issued to Girls' Farm School, Kundasale).
36. Tinley, N. L.—Good Pig Keeping.
37. Tinley, N. L.—Good Pig Keeping (Issued to Girls' Farm School, Kundasale).
38. Lowson, J. M.—Textbook of Botany, 9th Edition.
39. Lowson, J. M.—Textbook of Botany, 9th Edition (Issued to Girls' Farm School, Kundasale).
40. Practical Poultry Keeping, 4th Edition.
41. Practical Poultry Keeping, 4th Edition (Issued to Girls' Farm School, Kundasale).
42. Nettell, R. G.—Your Career in Poultry Breeding.
43. Nettell, R. G.—Your Career in Poultry Breeding (Issued to Girls' Farm School, Kundasale).
44. Maynard, L. A.—Animal Nutrition, 2nd Edition.
45. Maynard, L. A.—Animal Nutrition, 2nd Edition (Issued to Girls' Farm School, Kundasale).
46. Ling, E. R.—A Textbook of Dairy Chemistry, Vol. I, 2nd Edition (Issued to Girls' Farm School, Kundasale).
47. Ling, E. R.—A Textbook of Dairy Chemistry, Vol. II, 2nd Edition (Issued to Girls' Farm School, Kundasale).
48. Ford, E. B.—Mendelism and Evolution, 5th Edition (Issued to Girls' Farm School, Kundasale).
49. Diseases of Poultry—W. P. Blount (Issued to Girls' Farm School, Kundasale).
50. Hammond, Edwards et al.—The Artificial Insemination of Cattle (Issued to Girls' Farm School, Kundasale).
51. Cattle at the Crossroads—Littlebury and Co., Worcester (Issued to Girls' Farm School, Kundasale).
52. Whyte, R. O.—Crop Production and Environment (Issued to Girls' Farm School, Kundasale).
53. Craig, E.—Needlecraft, Revised Edition (Issued to Girls' Farm School, Kundasale).
54. Walter, H. E.—Genetics, 4th Edition (Issued to Girls' Farm School, Kundasale).
55. Hentschel and Cook—Biology for Medical Students, 4th Edition (Issued to Girls' Farm School, Kundasale).
56. Eckles, Combs and Macy—Milk and Milk Products, 3rd Edition (Issued to Girls' Farm School, Kundasale).
57. Hammond, J.—Farm Animals.
58. Hammond, J.—Farm Animals (Issued to Girls' Farm School, Kundasale).
59. Rice, V. A.—Breeding and Improvement of Farm Animals, 3rd Edition (Issued to Girls' Farm School, Kundasale).
60. Atlas Pluviometrics Do Brasil, 1914-1938.

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61. U. N. P. Independence Day Souvenir, 1950.
62. Ceylon Today: A Government by the People.
63. List of Plant Breeders in Canada and the U.S.A.—F.A.O., Washington.
64. Guide to Field Experiments, Demonstrations, and Farm Crops—Edinburgh School of Agriculture.
65. List of Egyptian Insects in the Collection of the Entomological Section.
66. Hobday—Surgical Diseases of the Dog and Cat—5th Edition (Issued to Specialist in Animal Husbandry, Diseases).
67. Brumley, O. V.—Diseases of the Small Domestic Animals, 4th Edition (Issued to Specialist in Animal Husbandry, Diseases).
68. Blount, W. P.—Diseases of Poultry (Issued to Specialist in Animal Husbandry, Diseases).
69. Wright, J. G.—Veterinary Anaesthesia, 2nd Edition (Issued to Specialist in Animal Husbandry, Diseases).
70. Hutrya, Marek et al.—Special Pathology and Therapeutics of the Diseases of Domestic Animals, Vols. I, II, and III, 5th Edition (Issued to Specialist in Animal Husbandry, Diseases).
71. Anthony, D. J.—Diseases of the Pig and its Husbandry, 3rd Edition (Issued to Specialist in Animal Husbandry, Diseases).
72. Felming—Veterinary Obstetrics, 4th Edition (Issued to Specialist in Animal Husbandry, Diseases).
73. Kirk, H.—Index of Treatment in Small Animal Practice (Issued to Specialist in Animal Husbandry, Diseases).
74. Kirk, H.—Index of Diagnosis, 3rd Edition (Issued to Specialist in Animal Husbandry, Diseases).
75. Hoare—Veterinary Materia Medica and Therapeutics (Issued to Specialist in Animal Husbandry, Diseases).
76. United States Department of Agriculture Yearbook, 1949.
77. The Agricultural Index, 1948-49.
78. Bailey, L. H.—The Pruning Manual (Issued to Horticultural Officer).
79. Bailey, L. H.—Manual of Cultivated Plants, Revised Edition (Issued to Horticultural Officer).
80. Knight, R. L.—Dictionary of Genetics (Issued to Botanist).
81. Beyer, G. H.—Farm Housing in the North East.
82. Ceylon Food Plan.
83. Fritsch & Salisbury—Plant Form and Function (Issued to Girls' Farm School, Kundasale).
84. Lush, J. L.—Animal Breeding Plans, 3rd Edition (Issued to Girls' Farm School, Kundasale).
85. Nichols, J. E.—Livestock Improvement, 3rd Edition (Issued to D. A. O. S. C., Bandarawela).
86. Macmillan, H. F.—Tropical Planting and Gardening, 5th Edition (Issued to Principal, School of Agriculture, Peradeniya).
87. Annual Report of the Smithsonian Institution, 1948.
88. Ignateiff, V.—Efficient Use of Fertilizers.

PERIODICALS

1. Board of Trade Journal.
2. British Agricultural Bulletin.
3. Ceylon Coconut Quarterly.
4. Countryman.
5. Dairyman.
6. Landscape Architecture.
7. Melhorumento.
8. Microentomology.
9. Milk Industry.
10. New York State Museum Educational Leaflet Series.
11. Sbornik.
12. New South Wales Soil Conservation Journal.
13. Vogue.

List of New Acquisition to the Library, Department of Agriculture, for the Period July 1 to September 30, 1950

BOOKS

1. Nielson Jones—The Growing Plant (Issued to A. R. O. E.).
2. Yapp & Nevens—Dairy Cattle, 3rd Edition (Issued to P. G. F. S. K.).
3. Barlow—Barlow's Tables, 4th Edition (Issued to A. R. O. E.).
4. Laboratory Manual for Queensland Sugar Mills, 2nd Edition (Issued to A. R. O. M. I.).
5. Jain—Farm Book Keeping, 1st Edition.
6. Jain—Farm Book Keeping, 1st Edition (Issued to A. R. O. M. I.).
7. Jain—Farm Book Keeping, 1st Edition (Issued to D. A. O. N. C.).
8. Jain—Farm Book Keeping, 1st Edition (Issued to D. A. O. N. W.).
9. Hine—Tractors on the Farm, 4th Edition.
10. Lewis—The Vegetable Products of Ceylon (Issued to P. G. F. S. K.).
11. Pearse—Growth Substances and their Practical Importance in Horticulture (Issued to A. R. O. E.).
12. Ashton—Technique of Breeding for Drought Resistance in Crops (Issued to A. R. O. E.).
13. Ashton—The Use of Heterosis in the Products of Agriculture (Issued to A. R. O. E.).
14. Wishart—Field Trials, their Layout and Statistical Analysis (Issued to A. R. O. E.).
15. An Outline of Cytological Technique for Plant Breeders (Issued to A. R. O. E.).
16. Hutcheson, Wolf and Kipps—The Production of Field Crops, 3rd Edition (Issued to A. R. O. E.).
17. Fisher—The Design of Experiments, 5th Edition (Issued to A. R. O. E.).
18. Snowden—The Cultivated Races of Sorghum (Issued to A. R. O. E.).
19. Fisher and Yates—Statistical Tables for Biological, Agriculture and Medical Research, 3rd Edition (Issued to A. R. O. E.).
20. Breeding Varieties Resistant to Diseases (Issued to A. R. O. E.).
21. Goulden—Methods of Statistical Analysis (Issued to A. R. O. E.).
22. Burkill—A Dictionary of the Economic Products of the Malay Peninsula, Vol. I (Issued to A. R. O. E.).
23. Burkill—A Dictionary of the Economic Products of the Malay Peninsula, Vol. II (Issued to A. R. O. E.).
24. Johnson—The Analyst's Laboratory Companion, 5th Edition (Issued to A. R. O. M. I.).
25. Browne and Zerban—Physical and Chemical Methods of Sugar Analysis (Issued to A. R. O. M. I.).
26. Macmillan—Tropical Planting and Gardening, 5th Edition (Issued to A. R. O. E.).
27. Tropical Soils in Relation to Tropical Crops (Issued to A. R. O. E.).
28. Gadd—The Commoner Diseases of Tea.
29. Ripper Abel et Al—Pest Control Farmers Handbook (Issued to Ento.).
30. Mather—Biometrical Genetics (Issued to A. R. O. E.).
31. Gadd—The Commoner Diseases of Tea (Issued to D. A.).
32. Gadd—The Commoner Diseases of Tea (Issued to D. D. A.).
33. Gadd—The Commoner Diseases of Tea (Issued to Patho).
34. Gadd—The Commoner Diseases of Tea (Issued to Ento).
35. Gadd—The Commoner Diseases of Tea (Issued to P. S. A.).
36. Gadd—The Commoner Diseases of Tea (Issued to Botanist).
37. Petch & Bisby—The Fungi of Ceylon.
38. Petch & Bisby—The Fungi of Ceylon.
39. Biggart—Pathology of the Nervous System, 2nd Edition (Issued to S. A. H. D.).
40. Tweed—Poultry Keeping in India, 8th Edition (Issued to S. A. H. D.).
41. Kelser & Schoenig—Manual of Veterinary Bacteriology, 5th Edition (Issued to S. A. H. D.).
42. Soil, People and Fertilizer Technology.
43. Wilson—How you Work (Issued to P. G. F. S. K.).
44. William—Principles of Agriculture (Issued to A. R. O. M. I.).
45. Moore—The Science and Practice of Grassland Farming (Issued to A. R. O. M. I.).
46. Darlington & Mather—Elements of Genetics (Issued to A. R. O. E.).
47. Turrentine—Potash.
48. Ellis—The Feeding of Farm Livestock.
49. Bates—Weed Control.
50. Farmer and Stockbreeder Yearbook, 1949.
51. McDougall—Plant Ecology, 4th Edition.
52. Lowe—Students Handbook to Fertilizers and Soils, Revised Edition.
53. Laity—Profitable Ley Farming.
54. Tidbury—The Clove Tree.
55. Fishwick—Dairy Farming Theory and Practice (Issued to S. A. H. D.).
56. Ukers—All About Tea Vol. I (Issued to P. G. F. S.).
57. Ukers—All About Tea Vol. II (Issued to P. G. F. S.).
58. Muenscher—Weeds.
59. Thomas—The Grazing Animal.
60. Davis—Field Machinery.
61. Watson—Feeding of Livestock.
62. Tyler—Organic Chemistry for Students of Agriculture.
63. Tothill—Agriculture in the Sudan.
64. Cox and Jackson—Crop Management and Soil Conservation, 2nd Edition
65. Efferson—Farm Records and Accounts.
66. Wirtschafter—Minerals in Nutrition.

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67. Winters—An Introduction to Breeding Farm Animals.
68. Lampert—Milk and Dairy Products.
69. Mitchel—Farm Accounts.
70. Farrall—Dairy Engineering.
71. Jain—Farm Bookkeeping. (Issued to F. M. Karadian Aru).
72. Waddington—An Introduction to Modern Genetics.
73. Browne & Zerban—Physical and Chemical Methods of Sugar Analysis. (Issued to Chemist.).
74. King—The Propagation of Plants.
75. Balfour—The Living Soil, 9th Edition.
76. Jaques—Plant Families. How to Know Them. 2nd Edition. (Issued to A. R. O. E.).
77. Leeper—Introduction to Soil Science.
78. Moore—The Science and Practice of Grassland Husbandry.
79. Gibbard—Classified List of Dahlias, 2nd Edition. (Issued to S. B. G.).
80. Langdon—The Tuberous Begonia. (Issued to S. B. G.).
81. Kerr & Bell—The Queensland Canegrowers Handbook.
82. Houghton—Aids to Practical Nursing, 5th Edition (Issued to P. G. F. S. K.).
83. Houghton—Aids to Practical Nursing, 5th Edition (Issued to P. G. F. S. K.).
84. Bailliere's Nurses Complete Medical Dictionary, 11th Edition (Issued to P. G. F. S. K.).
85. Australia Official Handbook.
86. Tidbury—The Clove Tree (Issued to Hort Officer.).
87. Leonard & Clarke—Field Plot Technique (Issued to A. R. O. E.).
88. Snedecor—Statistical Methods, 4th Edition (Issued to A. R. O. E.).
89. Bray & Dawe—Farm Accounts.
90. Sebels—Nutrition De Quelques Myxomycetes.

PERIODICALS

1. Annals Del Instituto Del Vino.
2. Australian Journal of Agricultural Research.
3. Boletim De Agricultura.
4. Canada Department of Agriculture Livestock and Poultry Division Annual Reports.
5. Cuttack Central Rice Research Institute Annual Reports.
6. Extension Service Review.
7. Farming.
8. F. A. O. Development Papers—Agriculture.
9. Journal of Experimental Botany.
10. Journal of the Science of Food and Agriculture.
11. Poultry Science.
12. Power Farmer.
13. Rodriguisia.
14. U. S. D. A. Agricultural Handbooks.
15. U. S. D. A. Agricultural Information Bulletins.
16. U. S. D. A. Forest Service Leaflets.

List of New Acquisitions to the Library, Department of Agriculture, for the Period April 1 to June 30, 1950

BOOKS

1. Miller and Robertson—Practical Animal Husbandry, 5th Edition. (Issued to Principal, Girls' Farm School.)
2. King—Farmers of Forty Centuries. (Issued to Principal, Girls' Farm School.)
3. Nelson—Principles of Agricultural Botany. (Issued to Botanist.)
5. Nelson—Principles of Agricultural Botany.
6. Kudo—Protozoology, 3rd Edition. (Issued to V.R.O.)
7. Craighead—Insect Enemies of Eastern Forests.
8. Lloyd—Science in Films.
9. Willis—The Birth and Spread of Plants.
10. Moore—Grassland Husbandry, 4th Edition.
11. Nadler—Modern Agricultural Mathematics.
12. Bear—Soils and Fertilizers, 3rd Edition.
13. Minnet—Gas and Air Analgesia, 4th Edition.
14. Puri—Soils, their Physics and Chemistry. (Issued to Chemist.)
15. Anon—Pacific Periodicals Survey.
16. F.A.O.—World Catalogue of Genetic Stocks—Wheat.
17. F.A.O.—World Catalogue of Genetic Stocks.—Rice.
18. Bodansky—Introduction to Physiological Chemistry. (Issued to V.R.O.)
19. Shumway—Introduction to Vertebrate Embryology. (Issued to V.R.O.)
20. Wheeler—The Miracle of Life. (Issued to Principal, Girls' Farm School.)
21. Kesteven—Some Important Animal Diseases in Europe.
22. Whyte and Sisam—The Establishment of Vegetation on Industrial Waste.
23. Loesecke—Bananas.
24. Anon—Home Institute Cookbook, Revised Edition. (Issued to Principal, Girls' Farm School.
25. Vaneslow and Liebig—Spectrochemical Methods.
26. Waddington—An Introduction to Modern Genetics. (Issued to A.R.O., M.I.)
27. Moore—Grassland Husbandry, 4th Edition. (Issued to D.A.O., Bandarawela.)
28. Piper, Abel et al.—Pest Control Farmer's Handbook.
29. Anon—British Insecticide and Fungicides, 1950.
30. Newton—Introduction to Physiology. (Issued to Principal, Girls' Farm School.)
31. Funnel—Aids to Hygiene for Nurses, 3rd Edition. (Issued to Principal, Girls' Farm School.)
32. Armstrong—Aids to Anatomy and Physiology for Nurses, 4th Edition. (Issued to Principal, Girls' Farm School.)
33. Armstrong—Aids to Anatomy and Physiology for Nurses, 4th Edition. (Issued to Principal, Girls' Farm School.)
34. Anon—Nomenclature of Fungi Pathogenic to Man and Animals. (Issued to Patho.)
35. Anon—The Production and Utilization of Silage.
36. Anon—The Colonial Office List 1950.
37. MacGregor—The Examination of Horses for Soundness.
38. Hart, Bond and Cunningham—Farm Management and Marketing. (Issued to D.A.O., Bandarawela.)
39. Cowen—Flowering Trees and Shrubs in India.

PERIODICALS

1. Australian Economic Survey.
2. Central Board of Irrigation, India—Journal.
3. Commonwealth Scientific and Industrial Research Organization Australia—Annual Report.
4. Commonwealth Scientific and Industrial Research Organization Australia—Bulletins.
5. Delpinoa.
6. Department of Scientific and Industrial Research Soil Bureau Bulletins.
7. Dominion Experimental Farms Annual Reports.
8. Economic Commission for Asia and the Far East, Bulletins.
9. Kenya Department of Veterinary Services Annual Reports.
10. Lenoxville Experiment Station Progress Reports.
11. National Agricultural Experiment Station Japan—Journal.
12. New South Wales Soil Conservation Service Journal.
13. Overseas Food Corporation Report and Accounts.

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14. Pakistan Journal of Science.
15. Phytomia.
16. Products Pharmaceutiques.
17. Revista de la Facultad de Ciencias Agrarias.
18. Rubber Research Institute of Malaya—Library Circulars
19. Sarawak Museum Journal.
20. Scientific Publications of South Asia—Bibliography.
21. Soil Survey Research Board Reports.
22. U. S. D. A. Information Bulletins.
23. Vogue Pattern Book.
24. Welsh Plant Breeding Station Advisory Bulletins.

List of New Acquisitions to the Library, Department of Agriculture, for the period January 1, 1951, to June 30, 1951

BOOKS

1. The Pineapple Industry of the Hawaiian Islands—Cooke.
2. Do. (Issued to Hort. Officer).
3. 35 m.m. Filmstrip Technique—Hansell.
4. The Living Soil, Revised Edition—Balfour.
5. Forage Crops—Ahlgren.
6. Good Grassland—Robinson.
7. Good Farm Accounting—Campbell.
8. Good Milk Farming—Robinson.
9. Good Control of Plant Diseases—Glassock.
10. Good Control of Insect Pests—Jary.
11. Water in the Physiology of Plants—Crafts, Currier, and Stocking
12. First Course in Hygiene 10th Edition—Lyster. (Issued to P. G. F. S. K.)
13. Do. do.
14. Modern Mothercraft—Pantin. do.
15. Elements of Soil Conservation—Bennett do.
16. Methods of Treating Rubber Latex, Part I.
17. Cow in India, Vol. I—Das Gupta.
18. Butter Industry, 3rd Edition—Hunziker.
19. Principles of Crop Husbandry in India—Narayan Iyer.
20. Agriculture—Science and Practice of British Farming, 8th Edition—Watson & Moore.
21. Condensed Milk and Milk Powder, 6th Edition—Hunziker.
22. Textbook of Dairy Chemistry, Vol. 2nd Edition—Ling.
23. Practical Bacteriology, 3rd Edition—Cunningham.
24. Textbook of Dairy Chemistry, Vol. II, 2nd Edition—Ling.
25. Bacteria in Relation to the Milk Supply—Chalmers.
26. New Biology IV—Johnson and Abercrombe.
27. Dairy Engineering—Farrall.
28. Standard Methods of the Analysis of Ghee.
29. Textbook of Physics, Vol. I—Devassy.
30. Do. Vol. II—Devassy.
31. Report on the Marketing of Ghee and other Milk products in India.
32. Report on the Co-operative Planning Committee, Bombay.
33. Milk Products, 2nd Edition—Harvey and Hill.
34. Milk Production and Control, 2nd Edition—Harvey and Hill.
35. Breeding and Improvement of Farm Animals—Rice.
36. 12th International Dairy Congress Proceedings. Vol. I.
37. Do. Vol. II.
38. Do. Vol. III.
39. Do. Vol. IV.
40. Dairy Industry in Sweden.
41. Milk Yield and Profit of Milk Production at Different Seasons of Calving—Brarimor & Homb.
42. The Production of Artificially Dried Grass—McNair & Fowler.
43. Milk Yield and Profit of Milk Production at Different Seasons of Calving—Homb.
44. Do. —Rogaland & Homb.
45. Alternate Husbandry. I. A. B. Joint Publication No. 6.
46. Indian Indigenous Milk Products—Davies.
47. Metorer och Resultat vid Avkommetdoming av Tjurar—Johanson.
48. Advances in Grassland Husbandry and Fodder Products.
49. Cereal Rusts—Chester.
50. Mathematical Treatment of the Results of Agric and other Expts., 2nd Edition—Van Uven.
51. Manual of Bryology—Verdoorn.
52. Manual of Pteridology—Verdoorn.
53. Genera Filicum—Copeland.
54. Sourcebook of Agricultural Chemistry—Browne.
55. Tropical Planting and Gardening, 5th Edition—MacMillian. (Issued to Botanist).
56. Sampling Methods for Censuses and Surveys—Yates. do.
57. Progress and Problems in Farm Mechanization—Anock.
58. Soil Conditions and Plant Growth, 8th Edition—Russel. (Issued to P. G. F. S. K.)

59. Coimbatore Canes in Cultivation—Dutt & Ras. (Issued to Botanist.)
60. Cacao Production in South America—Erneholm.
61. Introduced Mammals of New Zealand—Wodzicki.
62. Families of Dicolytedons—Gunderson.
63. Plant Viruses and Virus Diseases, 3rd Edition—Bawden.
64. Annotated Lists of the Grasses of the Uganda Protectorate, 2nd Edition—Eggling.
65. Laboratory Guide for a Course in General Botany—Bonar, Louch & Holman.
66. Methods of Analysis, 7th Edition—Lepper, Fisher et al. (Issued to A. R. O. N. C. D.)
67. Sugarcane Culture in Egypt—Dr. I. C. Van Dillewijn.
68. Field Instructions for Sugarcane Planters—I—Dr. I. C. Van Dillivija.
69. Pronouncing Dictionary of American English—Kenyon & Knott. (Issued to Sugar Expert).
70. Plant Embryology—Johanson.
71. Veterinary Helminthology and Entomology, 3rd Edition—Moniig.
72. Diseases of Field Crops—Dickson.
73. Nature and Prevention of Plant Diseases, 2nd Edition—Chester.
74. Farmers of the World —Brunner, Sanders, et al.
75. Conserving Soil Resources—Chapman Fitch et al.
76. Response of Crops and Soils to Fertilizers and Manures—Andrews.
77. Laboratory Manual of Parasitology—Ackert.
78. Design and Analysis of Factorial Expts.—Yates. (Issued to A. R. O. E.)
79. Galoya Valley Project in Ceylon—Brohier.
80. Conservation Handbook—Ordway.
81. Do.
82. Expts. in Soil Bacteriology—Allen.
83. Minutes of the House of Representatives, Ceylon, 1948-50.
84. Elements of Dairying, Revised Edition—Olson.
85. Hormones and Horticulture—Avery & Johnson.
86. First Lessons in Beekeeping, Revised Edition—Dadant.
87. Viruses and Virus Diseases of Plants—Cook.
88. Veterinary Protozoology—Morgan & Hawkins.
89. Sheep Science—Kammlade.
90. Principles of Servomechanism—Brown & Campbell.
91. Structural Geology—Billings.
92. Principles of Food Freezing—Gortner, Erdman. et al.
93. Insect Transmission of Plant Diseases—Leach.
94. Factors of Soil Formation—Jenny.
95. Farm Work Simplification—Vaughan & Hardin.
96. Structure of Economic Plants—Hayward. (Issued to Botanist.)
97. Using and Managing soils—Gustafson.
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